FEB 9

Engineering News-Record

A Consolidation of Engineering News and Engineering Record

McGRAW HILL COMPANY, Inc.

February 7 1918

In T

r Balcony C[illegible]oncrete Arch

B[illegible]

oronto Refuse Incinerator [illegible]ty [illegible]

Exceeds Co[illegible]t Pro[illegible]

[illegible] OSBOR[illegible]

uildin[illegible]gum

By [illegible]ODELL

Kreolite Lug Wood Blocks

"The Paving that's Saving"

One of the reasons why KREOLITE LUG WOOD BLOCKS were selected for this bridge was on account of the grade, which is 3.17%. The lugs on these four-inch blocks project one-quarter inch, giving the horses a much firmer footing than where a close-joint block is laid.

There will be no buckling or bulging of the floor, for when the blocks expand the lugs will compress, automatically absorbing the expansion.

THE JENNISON-WRIGHT COMPANY

2479 Broadway, TOLEDO, OHIO

BRANCH OFFICES

New York Philadelphia Cleveland Chicago
St. Louis Pittsburgh Cincinnati Toronto

Detroit-Superior High Level Bridge
CLEVELAND

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

Volume 80 — NEW YORK, THURSDAY, FEBRUARY 7, 1918 — Number 6

What of the Labor Situation?

What of the labor situation? Let us face the facts.

Labor is stronger today than ever before. It has tremendous power. It can for short periods stop industry. Within reason, it can force almost anything it will. If it goes to extremes the rural communities and large groups in the cities will rise to check and thwart its demands. Nevertheless, if misguided, it can work serious hardship. What, then, is its purpose? How will it use its power? Is it bent on a rule or ruin policy? Or, seeing the good in the existing order and conscious of the sure control that lies in the mass of the people, is it desirous of compromise?

Emphatically the latter is true—speaking as to the majority of the acknowledged labor leaders. Their desires cannot be realized unless capital comes half way. If capital resists, if it is represented—or rather misrepresented—by those who take an autocratic stand, it will force millions into the radical wing of the labor party, it will add fuel to fires already burning.

These are not the days for sugar coating the pill. The coward will cringe from facing the facts. He will roundly condemn those whose object is to save him—and with him the essential elements in the present social order. Charles M. Schwab said ten days ago that the worker was to dominate the world. A more temperate statement is that of former Supreme Court Justice Hughes, a student of industrial relations, accustomed to consider and weigh. Before the New York Bar Association last month he said:

"Individual privilege [in the future] will have to show cause before a public to which old traditions are no longer controlling—a public trained in sacrifice—which will enforce its own estimate of the common right." And again he said, "The present exercise of authority over the lives of men will hereafter find its counterpart in a more liberal exercise of power over the conduct, opportunities and possessions of men."

Mr. Schwab and Justice Hughes had the courage to recognize the changing order. Narrow minds, however, will rail and rant, urge that capital prepare to fight for its position, and declare that no man shall dictate how they shall run their plants. Such minds are not changed by dissertations on the reasonableness of the new order, which decrees that the public good shall take precedence over private gain, that the public cares for the individual, and demands that he shall have a voice in determining the conditions under which he works.

It is a matter of indifference, in any event, what the individual thinks as to the soundness of the coming order. We are in a new era, in fact. Witness the fires raging socially in Russia and now kindling in Austria and even in Germany. Note the power which labor has in England.

We are in and of the world. The power drifting to the workers here is part of the world tide. Whither will it lead us?

Even as there are standpat autocrats as well as men of enlightenment among employers, so there are radicals and conservatives among labor. The autocrats on the one hand and the radicals on the other are the extremists. If they are left to lead us out of the difficulties, we shall have an arming for conflict and a great catastrophe. It is for those who see the light to compose the differences—the moderates among the employers, the conservatives among the workers.

These wings of the opposing parties can reach a working agreement. They must come together in order that the extremists may be disarmed—aye, that they, and the country with them, shall be saved from their own madness. The final result will work for the greater good of all. "Harsh changes are necessary," said Mr. Schwab, "but they will be more than repaid not only materially, but in happiness and contentment."

Practically, what is coming out of the present economic crisis? Detailed predictions are dangerous. This much is certain: (1) Labor will demand and get a larger share of the profits of industry and (2) it will demand a voice in each industry in determining the conditions under which it shall work.

Is that a cure-all? Will all labor difficulties be then composed?

Not so. There is not an absolute unity of interest; there cannot be a permanent peace. All we can hope for is compromise under conditions that obtain today When conditions change, there will be a new compromise, succeeded by another and another and still another. But the present compromise will be the

greatest for many a day, for it will definitely establish labor's voice in the control of industry.

And what of the industries that pay a bare four or five per cent. on a fair or low valuation of investment? Bankruptcy or a reduction of overhead through increased production. These are the only alternatives.

And what of efficiency, now at a low mark in industrial plants? Education is the answer—education, through participation in management, regarding the factors which affect profits; education which will engender a sense of responsibility for the success of the industry, a realization that there can be no labor prosperity without industrial prosperity—a realization that will be turned into effective action by confidence that labor will get "its share" of the profits it helps to create. A long process, yes, but a necessary one.

And efficiency is a shoe that both parties can wear. Management inefficiency more than matches, count for count, labor inefficiency.

Radical talk this? Yes, if you will have it so, but read again the words of Charles Schwab and of Justice Hughes.

Shall we fear to face the facts? Shall we, by ignoring conditions that the merest numskull can appreciate, drift into anarchy? *Laissez faire* and "last-ditch resistance" both lead to that end.

Soon there will meet in Washington a Labor Policy Board. It will hold the balances for our industrial peace. There must be give and take—compromise. Both sides must surrender much that they value highly. Far-seeing employers are ready to make sacrifices. So, too, are the forward-looking labor leaders. The interests of the country demand that both sides look carefully to it that they be not misrepresented.

And above all let both be prepared for large concessions. In that direction lies peace and the country's good.

Do We Need Safer Columns?

THE final accounting on an unusual trusteeship is represented by the report with which the steel column committee of the American Society of Civil Engineers has closed its nine years of labor. As such, the report takes on an importance far beyond that residing in its technical facts. A large sum of public money was spent to make tests. For this money, a trust fund given into the keeping of the engineering profession, we must show an adequate return.

That the committee, on which this obligation primarily rested, was sensible of the burden of special responsibility is apparent from the painstaking detail of the report. Now that the committee has withdrawn from the work, the obligation reverts to the other members of the society, and for that matter to all structural engineers. Theirs the task of analyzing the test results and verifying or perhaps adding to the committee's deductions, in order to secure the maximum benefit for the public. "It is peculiarly incumbent upon the society to see that these test results are exhaustively analyzed," so the case was stated in this column a year ago.

Highest praise is due the committee for the thought and labor devoted to the studies, as well as for the long, arduous service given to the profession. Praise is due no less to the officials of the Bureau of Standards for the conscientious way in which the tests were carried out. The world's store of technical data has been enriched by a coherent test series on steel compression members far surpassing any prior tests in this field—indeed, probably of greater value than all the earlier tests combined.

This series, planned and executed as a means of making construction more efficient, should yield practical results commensurate with its inherent excellence. Without deprecating the abstract value of the test work, one may properly apply the severe criterion of practical gain, in seeking to determine how well the expenditure involved has been turned to account for the good of the public. It would be disappointing, in a measure, were we to learn that the tests merely confirm existing views and practices. If, however, they teach us how to build columns more cheaply, or for a given cost to build them better; or if they tell us how to build more safely, by revealing unsuspected dangers, then a real gain will have been recorded.

It comes as something of a shock to those engineers who have felt secure in the conservatism of past designing practice, that the committee in effect declares the working loads used on steel columns unsafe. It recommends lower loading. The figure of 12,000 pounds per square inch of cross-section is to be the maximum, and this only in the case of solid-section struts with perfect square-end bearing—a specially favorable case. Considerably higher loadings are used today.

Expectations of a gain in economy, then, are not to be realized. Never would reduced cost of steel construction by more efficient utilization of the material be a greater boon than in the period we are now entering; every kind of metal needs to be utilized to its utmost capacity during the years that will elaspe before the world's accumulated shortages are made up. But if practice adopts the committee's recommendation, nearly every kind of construction will become more costly. Increased safety is the justification, but only if the greater safety is really needed.

A wide field for expert discussion separates the committee's conclusion from the strength figures which the tests produced. The intricate technical questions within this field demand most thorough discussion. But factors of safety are not readily amenable to mathematical derivation, and in the final outcome the discussion is bound to make the practical conclusions depend on the question whether columns as now built are sufficiently safe.

A serious allegation is made by the committee with reference to this question. The report says, "The engineering profession does not need to be reminded of accidents which have been caused by the failure of columns." Engineers of wide information, interviewed on this matter, have not recalled accidents of the kind suggested. Is the committee's statement intended to conjure up visions of the Quebec chord, of the Panama

crane strut, and of similar flimsily assembled open-section members? If so, the plain answer must be made that they have nothing to do with the case. The committee says clearly that its studies were confined to "sections designed to avoid the necessity of latticing or battens, and tested with square ends," in other words, to solid-metal sections with flat end bearings.

That the "accidents" referred to in the quotation had distinct influence in shaping the committee's recommendations is fairly evident. The report has a subjective phase that is not negligible. The recommended stress is not so much a deduction from test results as it is a reflection of the committee's judgment. It is interesting—quite natural—that even so precise and consistent a series of column tests as the present one does not lead us to direct and positive results, but requires interpretation by judgment.

No more delicate questions come to the engineer than those in which a line must be drawn between adequate safety and unnecessary caution. When is our safety margin excessive and when is it brought down so low that we may be surprised by disaster? It is dangerous to attack such a question in a dogmatic spirit. For the same reason a definitely stated relation between test results and recommended working load should not be looked for in the present instance.

But precisely on this account is it necessary that thorough analysis of the tests and of the practical modifying factors be brought to bear on the subject by the society and by other engineers. Until the judgment of the profession is joined to the judgment of the committee, the implied charge against the safety of present-day columns cannot stand as established, and therewith the urging for more costly column construction to eradicate the dangers claimed to exist loses its force.

Decision Needed on Waterway Control

IF THE canals are to play any part in relieving the freight situation by next summer, the various governmental agencies in Washington had better get together pretty quick to decide how much, if any, governmental assistance is to be given to these waterways. The New York State Barge Canal, for instance, will be opened from tidewater to Lake Ontario inside of four months. The state engineer confidently expects that the 12-ft. channel will be carried through to Lake Erie by May 15. Although this will constitute a modern, well-equipped transportation route ready to hand, practically no freight will be carried on it next summer unless an expensive building program is immediately started. There are only old barges, insufficient in number to navigate the canal. There are few, if any, on the ways. In spite of an intensive campaign by state authorities, there is no evidence that private capital is embarking on a barge construction program. The same is true of other inland waterways, though not to so great an extent in the case of the larger rivers, such as the Ohio. Meanwhile at Washington, Director-General McAdoo testified before the Senate Interstate Commerce Committee that if it should develop that the operation of canals is necessary they might be taken over; and that such action would also be extended to the operation of river traffic. Rumor also has it that the War Department is drafting a bill providing a large appropriation for the construction and purchase of barges for inland-waterway traffic, exclusive of the subsidy already provided for the Mississippi River. As long as there is possibility of government action private capital will not engage in the construction of waterway equipment, and unless the building of new barges is started very soon next summer will see a repetition of last summer's inactivity. It behooves the Federal authorities to get together and to decide immediately whether or not the government will devote itself to the development of river and canal traffic.

Shipping Capacity Affects Every Major War-Industry Problem

THE government is enforcing production curtailment. That is the purpose of the Garfield holidays, and of the 25 per cent. fuel saving being asked of various industries. The degree of curtailment requested, however, has no scientific basis. No one knows whether the available shipping capacity requires a 10 per cent. or a 50 per cent. reduction. Worse still, no one is trying to find out. Yet, on the careful determination of the relation of output to available cargo space depend the operation of industries, the distribution, supply and wages of labor, the housing program, prospective railroad expansion—in fact, every major problem of our war industry.

There are big problems pressing for solution in Washington, but none more important than this. Of what use to let new contracts, if they are shortly to be canceled or suspended. Of what avail to speed up industries, if they are later to be slowed down. To what purpose recruit labor forces at great expense, if the organizations are to be disrupted through layoffs.

Let us face the conditions frankly. We are in danger of severe disturbances. An unofficial inquiry recently made in Washington brought the investigators to the conclusion that we will produce in 1918 for oversea use three times as much as we can ship. Suppose the supply is only twice as much, or 50 per cent. more. The situation still is serious, even granting the storage possibilities—and storage needs cannot be intelligently estimated until there is a central intelligence in Washington charged with summarizing the tonnage in prospect and balancing it against shipping capacity.

It is a big job, an important job. It involves really knowing how much new tonnage will go into the water this year, knowing what the Emergency Fleet Corporation will actually do.

Until this job is done, we shall go forward with bungling efforts at curtailment, relying on patriotic appeals for support of the measures rather than on facts. Meanwhile, we may embark on a housing program two or three times larger than needed, on labor recruitment which will result first in unnecessarily high wages and later in severe labor disturbances, on transportation and storage measures that might be unnecessary were the facts available.

The facts are needed—and needed at once. Without a doubt the acting quartermaster-general, who is also in charge of all transportation of army supplies, will take the matter in hand, now that his work of reorganization is well forward. He can act none too quickly.

One-Hundred-Foot Concrete Arch Carries Theater Balcony

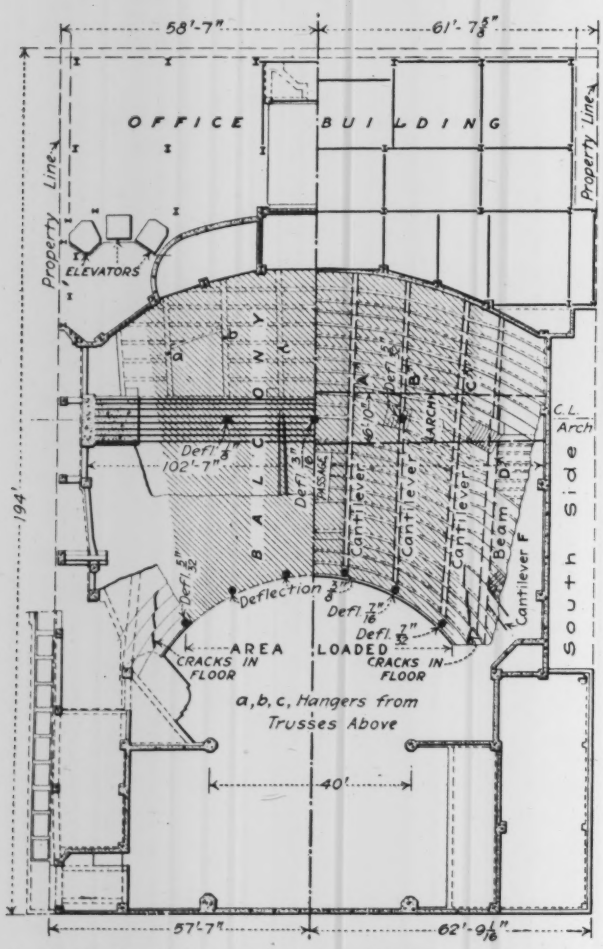
Expense and Delay Incident to Steel Frame Forces Use of Fulcrum of Unique Design for Cantilevers—Deflections Safe Under Twice Designed Load

By Clarence W. Driver
Structural Engineer, Los Angeles

INABILITY to secure delivery of steel from eastern fabricators within 18 months practically forced the designers of a theater in the Edison building in Los Angeles to work out in concrete an unprecedented detail for building work—a 104-ft. arch to serve as the fulcrum support for six cantilevers under the balcony. Otherwise the work would have been held up at least one year, for none of the shops on the Pacific coast had facilities for handling such a long steel truss.

The 12-story office section of the structure, 115 x 65 ft., is to be occupied by the Southern California Edison Co. It has a frontage of 115 ft. on Broadway and 65 ft. on Third St. Behind this is the theater with an entrance on Broadway through the center panel of the office building. The auditorium is 106 x 103 ft. in plan and has one balcony, 70 ft. long, and the same width as the main floor. There are 1400 seats on the main floor and 950 on the balcony. Although the theater will be used as a moving-picture house for the present, it was designed for legitimate drama or opera and has a proscenium arch 40 ft. wide and 40 ft. high, and a stage 35 ft. deep furnished with all necessary mechanical equipment, gridiron, fly galleries and dressing rooms.

The framework of the office section is of structural steel, but reinforced concrete is used in the remainder of the building, except for the steel roof trusses over the auditorium and the steel gridiron over the stage. In accordance with modern practice in theater construction, no columns are used in the clear space of the auditorium to support the balcony, but the entire load of the balcony is transferred to two wall columns by means of a reinforced-concrete arch with tie-rods, instead of using the usual steel truss. The design of the balcony was first worked out in structural steel, using a large fulcrum truss and six overhanging cantilever trusses. However, the fulcrum truss was of such size that it could not be fabricated by the local steel contractors, and the cost, as figured by a large eastern company, so prohibitive and their promised time of delivery so late that the design had to be abandoned. The high cost of steel necessitated the use of concrete, and after several different schemes had been worked out, the design as shown in detail on the accompanying plans was adopted.



HALF PLANS OF LOS ANGELES CONCRETE THEATER, IN WHICH BALCONY IS CARRIED BY 104-FOOT CONCRETE ARCH

FORMS AND REINFORCEMENT IN PLACE ON THE CANTILEVERS—FULCRUM ARCH IN BACKGROUND

LARGE COLUMN CARRYING CONCRETE ARCH

The reinforced-concrete arch is 12 ft. wide, 3 ft. thick at the crown and 5 ft. thick at the springing line. It is carried by two large wall columns, 3 ft. thick by 12 ft. wide, and the thrust is taken by 180 1¼-in. tie rods 109 ft. long, threaded on both ends and bolted to end plates. The arch is reinforced with 80 1-in. square twisted rods, and each of the supporting columns with 84 1¼-in. square twisted rods.

The overhang is carried on six cantilever reinforced-concrete trusses, which rest on the arch and are tied to the office building at the third and fourth floor levels. The uplift from these cantilevers is taken by steel beams in the rear wall of the office building. A small area near the front of the balcony on each side is carried by two cantilever beams directly to the wall beams and columns. The seat risers are reinforced as beams and carry the floor load to the cantilevers. The mezzanine under the balcony is suspended from cantilevers and the arch.

A live-load of 125 lb. per sq.ft. over the entire balcony and mezzanine was used in making the design. In the tension steel the stresses in the cantilevers do not exceed 18,000 lb. per sq.in. and in the compression members, which are designed as spirally hooped columns, the concrete is stressed up to 800 lb. per sq.in. The stresses in the arch do not exceed 650 lb. per sq.in. on the concrete and were determined by the method of influence lines. The stresses in the arch tie rods were calculated to be about 14,000 lb. per sq.in.

The arch was poured in one day. The forms under the weight of the wet concrete settled at the different points of support from ⅛ in. to ½ in. due to the crushing of the timber or the settlement of the footings. Considerable time was consumed after the arch was poured in framing and pouring the cantilevers and 2½ months elapsed before the supports were removed from under the balcony. They were all taken out on the same day and there was no deflection. The floor of the front row of seats of the balcony is 30 in. higher in the center than at the sides, the second row is 27 in. higher and so on up the balcony. This, in the opinion of the engineers, caused the seat risers to act as a series of arches between the side walls and columns and thus explains the lack of deflection in the front of the balcony. Later, however, load tests were made on the balcony and deflections of varying amounts were recorded, as will be described.

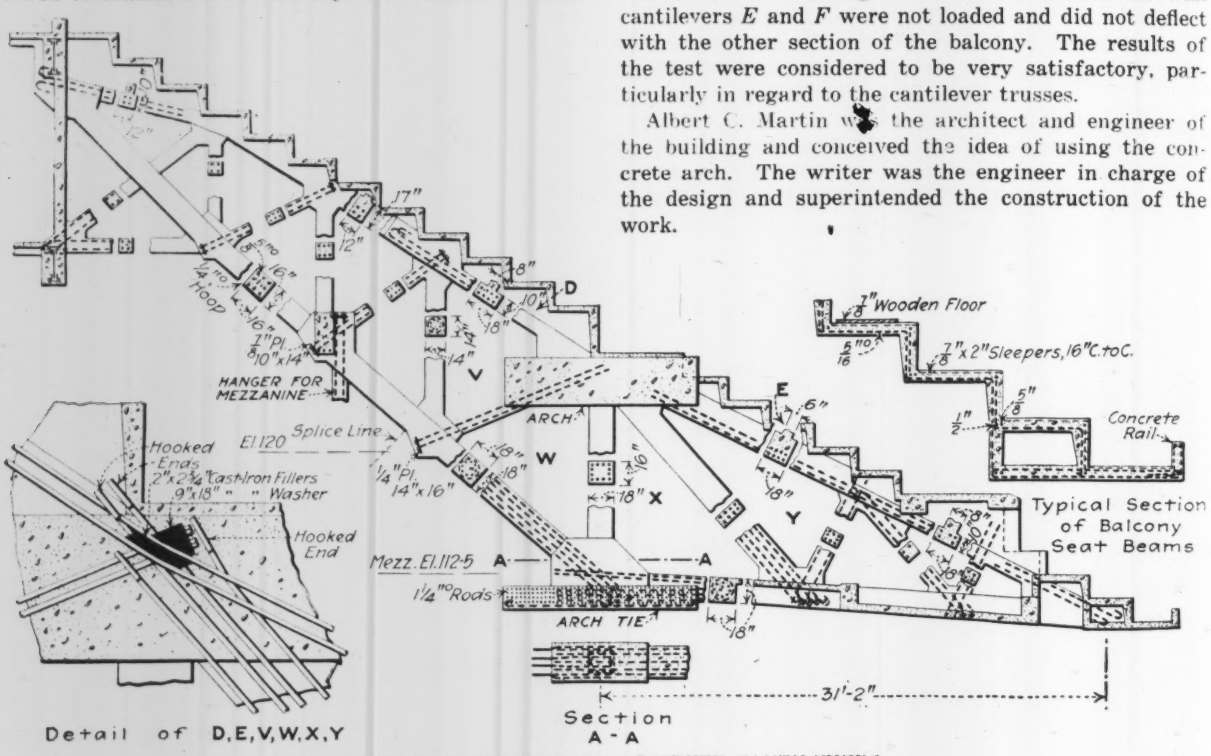
Although the officials of the building department had checked and approved the balcony design and all the details, and had inspected the construction, they seemed

UNDERNEATH THE FULCRUM ARCH AND BRACKETS IN NEW CONCRETE THEATER AT LOS ANGELES

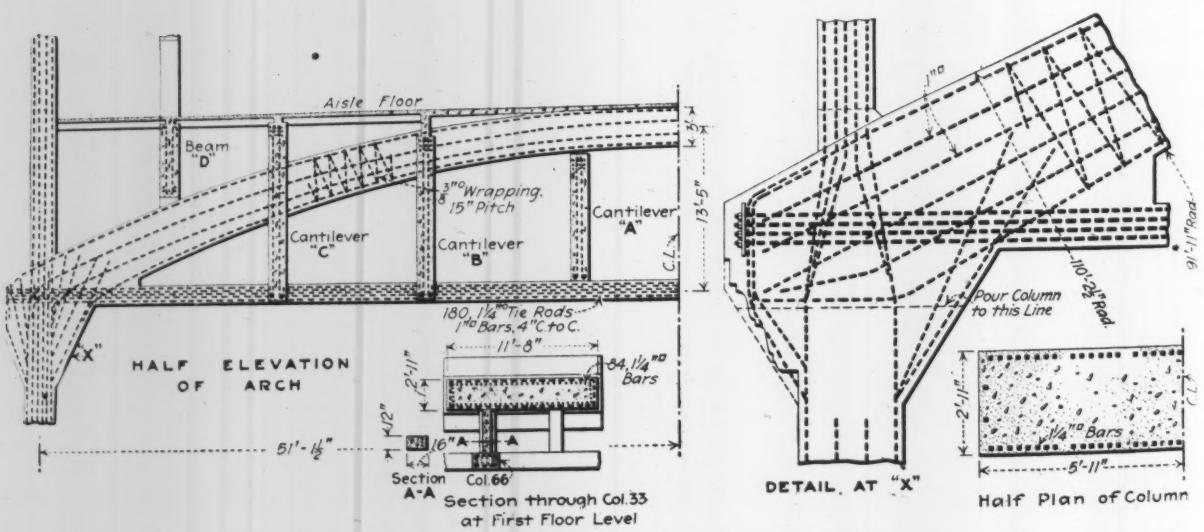
to be skeptical of the strength of the structure and demanded that the entire balcony should be tested with an actual load of 250 lb. per sq.ft., equivalent to twice the designed load. This loading caused stresses in the tension members of the cantilevers, which were calculated to be as high as 25,000 lb. per sq.in. in the steel.

The south cantilever *B* was loaded first, using sacks of cement. It deflected at the front end $\frac{3}{16}$ in., the arch under the cantilever lowered $\frac{3}{32}$ in. and the tie rods of the arch stretched $\frac{3}{32}$ in. This loading was a severe test of the cantilever and also of the arch, on account of the eccentric loading on the latter. The load was allowed to remain for several days and then the remaining area of the balcony, carried by the six large cantilevers, was loaded. Materials to be used in completing the building—cement, brick, plaster and sand—were used and nearly a week was consumed in placing the load. The total load amounted to 1,300,000 lb. and was distributed uniformly over the area shown by hatched lines on one of the drawings. The deflections at the front ends of the six cantilevers and at the center and quarter points of the arch are marked on the same drawing. The elongation of the tension rods of the arch showed an increase to $\frac{1}{8}$ in. on the south end and $\frac{1}{16}$ in. on the north end. The only cracks that appeared are located on the drawing and occurred because the wall cantilevers *E* and *F* were not loaded and did not deflect with the other section of the balcony. The results of the test were considered to be very satisfactory, particularly in regard to the cantilever trusses.

Albert C. Martin was the architect and engineer of the building and conceived the idea of using the concrete arch. The writer was the engineer in charge of the design and superintended the construction of the work.



DETAILS OF REINFORCED-CONCRETE CANTILEVERS



DETAILS OF THE CONCRETE ARCH WHICH CARRIES THE BALCONY

How Belgium Will Be Rebuilt After the War

Council of Economic Affairs Is Ready To Plunge In as Soon as Huns Are Forced Out and Rehabilitate Highways, Canals, Railroads and Towns

By John M. Goodell

THE Belgian War Commission has recently permitted the examination of a number of official documents outlining the preparations of the government of that country to rehabilitate it as soon as the war is over. The great task is approached with full appreciation of its enormity but with equal confidence in its success. A commission has already been sent to the United States to investigate our methods of securing efficiency in industrial and commercial activities, that every resource of the Belgian people may be utilized in the best possible manner when the opportunity to reconstruct the life of the country arrives. At present it is, of course, impossible to prepare detailed plans, but the general project is being worked out on lines explained as follows last November by Baron de Broqueville, minister of foreign affairs:

"The first idea of the government, after the line of fire between us and our people has died out, will be to call together those who have merited public confidence while under the yoke of the enemy, for the purpose of a consultation with those having competence and authority. There will be a mutual exchange of the fruits of our studies and experiences. At present the rôle of the government is to inaugurate preliminary studies, to investigate different solutions of our problems between which it will be necessary for us to choose some day, and to compile a great mass of diverse data. The ministerial departments are devoting themselves actively to this work, and the creation of a ministry of economic affairs shows clearly how desirous of completing the task is the government. When the hour to work comes it will be seen that we are not afraid of new men, new ideas and new methods."

Council of Economic Affairs Organized

The minister of economic affairs, who is particularly charged with the preparations to restore the economic life of Belgium, is Paul Hymans. Immediately after taking office he organized a Belgian economic council of men experienced in affairs and acquainted with the needs of industrial and commercial enterprises and of agriculture. It is these men who are aiding Mr. Hyman to develop, before the government returns to the liberated land, the foundations for a policy which will revivify a country harassed by the exactions of a pitiless invader. Each of the government departments is represented in the council, so that nothing will be done which will conflict with the plans of other ministries, while the council will have the advantage of knowing the views of the other departments and of obtaining prompt assistance from them.

One of the first problems will be that of procuring labor and setting it at work on tasks for which it is adapted. In addition to reorganizing the labor which will become available in Belgium when it is reoccupied there will be the task of repatriating the laborers who escaped to France, England and Holland. The government is already carrying on some measures of industrial insurance, workmen's compensation and sick benefits among the Belgians in foreign countries. It is also conducting night schools in many of the refugee centers, where trades are taught which will be particularly useful when these people return to their country.

Highways to Be Repaired First

The repair of the transportation agencies will become urgent as soon as the enemy withdraws. At first travel will be largely by highways, it is believed, and materials have been arranged for with which to restore bridges, waterways and roads to serviceable condition. It is impossible now to say what state the canals will be in when they return to the control of the Belgian authorities, but if they are left like those in the liberated portion of France they will be badly injured. Their floating equipment has been greatly diminished by German requisitions, and a commission has been appointed to investigate French and English methods of boat building, so that the new equipment will contain all the useful features now peculiar to recent progress in those countries. The general subject of internal navigation is considered very important by the Belgian authorities, and a report last November by the minister of agriculture and public works states that the Germans are giving even more attention to this subject than before the war.

The 7000 railway employees who left the country have been sought out and organized for the reconstruction of the lines. Some are now serving in military railway battalions carrying on work behind the fighting front, and others are preparing to operate the lines as soon as they can be taken over by the Belgian government. Those not employed in these ways are mostly engaged on the French railways and in the French munition factories.

Much Railway Equipment Saved from Germans

During the retreat from Belgium 11,000 open and closed freight cars, 1700 passenger cars and 1900 locomotives were removed safely in order that they could be repaired and placed at the service of the Allies. A yard with more than 25 miles of track was constructed, and shops employing 1500 men were built for carrying on the repairs. Large additions to these facilities are now being made. A large quantity of track materials, including rails, has been gathered for the reconstruction of part of the railways as soon as the work becomes possible. This reconstruction will require a large amount of money, and it is hoped that part of it will be advanced by the United States.

In the devastated part of the country about 45,000 houses and other buildings must be reconstructed without loss of time as the land is freed. Temporary quar-

ters are under consideration, for it is believed that the permanent reconstruction should be substantial and entirely appropriate for the purposes to which the buildings are put. Former plans for the development of many of the cities and towns were mostly prepared for slow execution and not for conditions like those now existing. The obstacles which formerly stood in the way of city planning have been swept away to a considerable degree by the ravages of the enemy, and projected improvements can now be planned to meet conditions formerly existing only in open country. Particular attention is being paid to workmen's homes, to sanitation, to city planning as affected by local transportation facilities and to the good appearance of the new structures.

Quartermaster General's Office Is Reorganized

Storage and Traffic Service Established—Four Service Bureaus and Eleven Operating Divisions Created

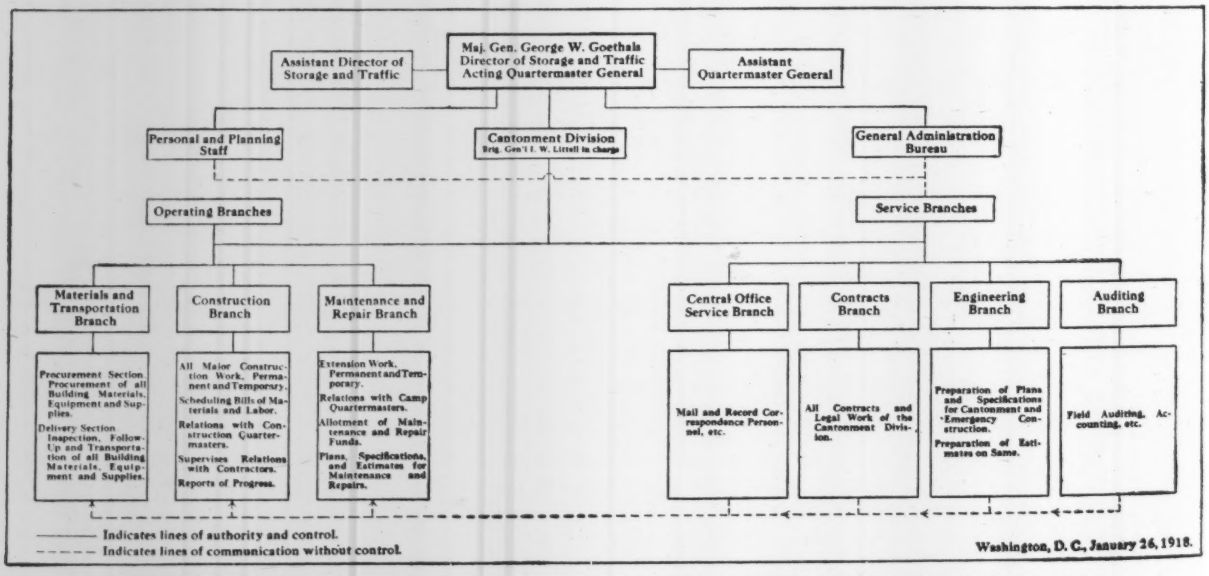
THE reorganization of the staff of the Quartermaster General completed by Gen. George W. Goethals on Jan. 26 includes the general rearrangement of the administrative boards into service bureaus and operating divisions, and the creation of a storage and traffic service for the general staff. One of the diagrams shows the general reorganization scheme for the entire office, while the other shows the new constitution of the cantonment division, the operating branch of which is most closely connected with the engineering construction carried on by the Quartermaster General.

The service bureaus are established for the purpose of performing administrative, controlling and planning functions for the operating divisions. In the general scheme of the new organization there are three of these bureaus, two of which are identical with the service bureaus affording special service to the storage and traffic organization. The four operating divisions of this latter service, however, are also served by a fourth bureau, the Distribution Priorities Bureau. The function of this service will be to advise the director of storage and traffic with respect to all matters of priority and distribution, and to hold proceedings and secure information on which to base the apportionment of the use of storage, transportation and embarkation facilities among the various operating divisions.

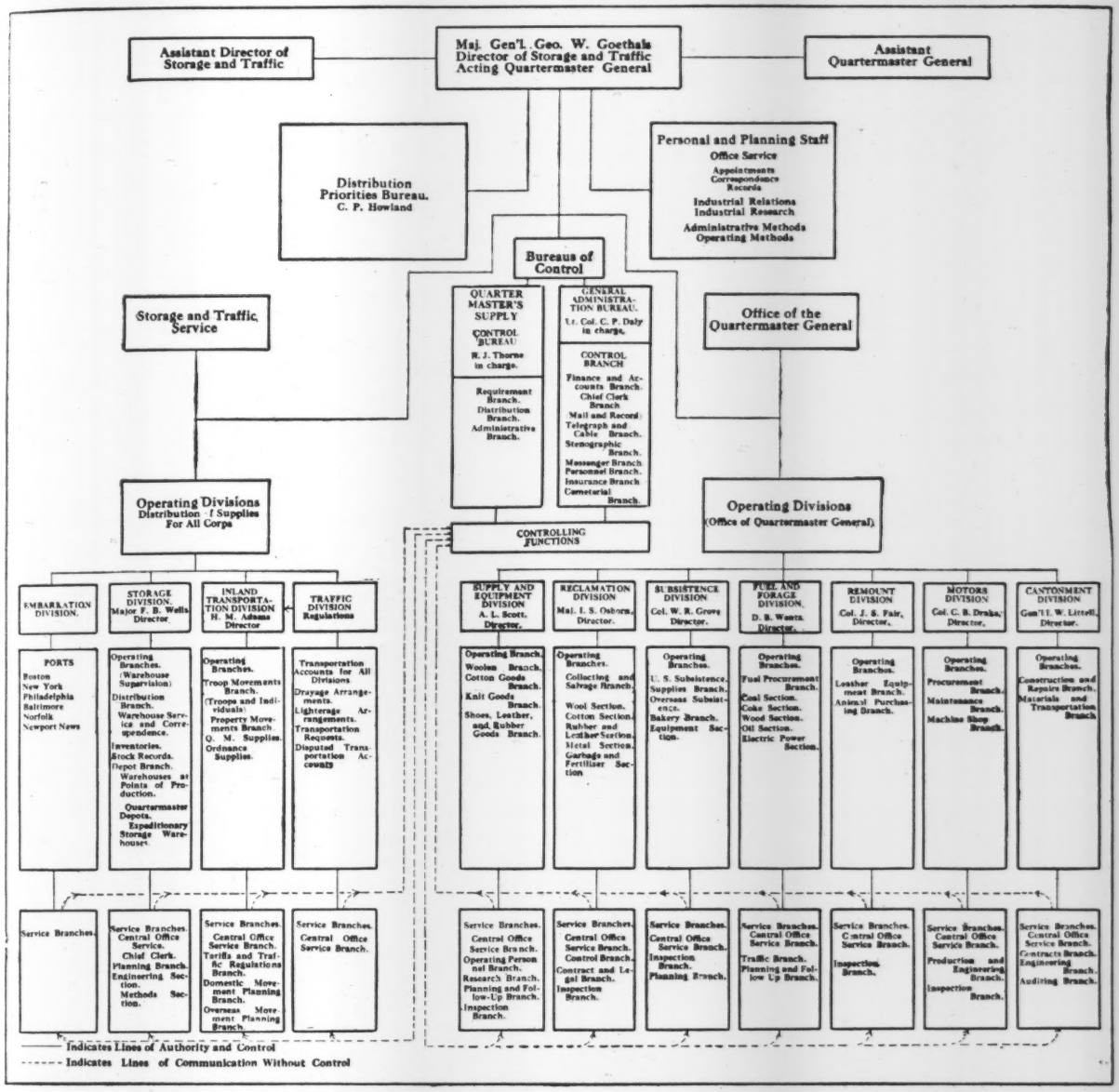
The three other bureaus, the first and last of which serve both the storage and traffic director and the main organization proper, are the General Administrative Bureau, the Quartermaster Supply Control Bureau and the Personal and Planning Staff. The first of these includes a control section in charge of the interpretation of reports and statistics for executive attention and the preparation of orders for executive action, the verification and approval of estimates, of requests and orders from the operating divisions, and the working out of forms and routine for administrative procedure in the various offices of the quartermaster corps. This bureau also includes an information and statistics section (which serves both the Quartermaster General and the Quartermaster Supply Control Bureau), and a contract supervision section.

The Quartermaster Supply Control Bureau is organized with a requirement branch, a distribution branch which attends to the needs of both domestic and overseas troops, and an administrative branch. The first branch is subdivided into the total supply requirement section and the procurement requirement section, the first of which prepares statistics showing the quantities of supplies required, the storage, car and cargo space needed, the motor and horse transportation necessary and the reserve supplies which must be carried to prevent shortages. The procurement requirement section prepares exact orders for the various services on the basis of which articles are purchased by the procurement sections of the various operating divisions.

The Personal and Planning Staff supervises and coördinates all matters relating to office service, administrative methods, operating methods, industrial research


Assistant Director of Storage and Traffic
Maj. Gen. George W. Goethals Director of Storage and Traffic Acting Quartermaster General
Assistant Quartermaster General
Personal and Planning Staff
Cantonment Division Brig. Gen'l F. W. Littell in charge
General Administration Bureau
Operating Branches
Service Branches
Materials and Transportation Branch
Construction Branch
Maintenance and Repair Branch
Central Office Service Branch
Contracts Branch
Engineering Branch
Auditing Branch
Procurement Section. Procurement of all Building Materials, Equipment and Supplies.
Delivery Section. Inspection, Follow-Up and Transportation of all Building Materials, Equipment and Supplies.
All Major Construction Work, Permanent and Temporary.
Scheduling Bills of Materials and Labor.
Relations with Construction Quartermasters.
Supervises Relations with Contractors.
Reports of Progress.
Extension Work, Permanent and Temporary.
Relations with Camp Quartermasters.
Allotment of Maintenance and Repair Funds.
Plans, Specifications, and Estimates for Maintenance and Repairs.
Mail and Record Correspondence Personnel, etc.
All Contracts and Legal Work of the Cantonment Division.
Preparation of Plans and Specifications for Cantonment and Emergency Construction.
Preparation of Estimates on Same.
Field Auditing, Accounting, etc.
Indicates lines of authority and control.
Indicates lines of communication without control.
Washington, D. C., January 26, 1918.

SERVICE BUREAUS GIVE HEADS OF OPERATING DIVISION INFORMATION ON WHICH TO ACT



CANTONMENT DIVISION EXPANDED TO CARE FOR MAINTENANCE AND REPAIRS

and industrial relations for the several operating divisions. Its work includes inquiry and recommendation with respect to subjects and methods of research, investigation, planning and advice on all matters of labor and personnel. In this latter capacity it will have charge of the coördination and classification of grades and ranks, together with the development of courses and methods of instruction for use in the training of personnels.

The operating divisions established for the office of the Director of Storage and Traffic Service include the Inland Transportation Division, the Storage Division, the Embarkation Division and the Traffic Division. This last is concerned chiefly with coördinating the work of handling questions arising out of the transportation of officers and civilians and the handling of expense accounts.

In the reorganization of the immediate staff of the Quartermaster General seven operating divisions have been created. These include the Supply and Equipment Division, the Reclamation Division, the Subsistence Division, the Fuel and Forage Division, the Remount Division, the Motors Division and the Cantonment Division. Each of these executive divisions, in so far as it buys materials, has its own procurement branch and production branch, coöperating with the sections of the service bureaus which are designed to assist in their work.

The organization of the Cantonment Division, which is most closely concerned with engineering construction, is typical. This division has six branches in charge respectively of materials and transportation, construction, maintenance and repair, engineering, central office service and auditing. The first branch includes procure-

ment and delivery sections which serve the second and third branches. All major construction work is supervised by the second branch, while the third branch in addition to maintenance and repair work is in charge of extensions. The duties of the engineering branch are confined to the preparation of plans, specifications and estimates. The central office service branch coöperates with the General Administrative Bureau in all matters pertaining to personnel, takes care of the office work of the division, and prepares the office payrolls. The auditing branch, with a field auditor at the location of each construction project, handles all accounts, matters pertaining to the financing of work, and insurance.

Low Working Stress for Square-End Steel Columns Is Recommended

Final Committee Report to American Society of Civil Engineers on 213 Tests Emphasizes Variation in Strength Caused by Non-Uniformity of Metal and Proposes 12,000 Lb. per Sq.In. as Limiting Load

REDUCTION of the maximum working stress for steel columns to 12,000 lb. per sq.in. was recommended by the Column Committee of the American Society of Civil Engineers in its final report, submitted at the meeting of Jan. 16, 1918. Only square-end columns are referred to: "The Committee's report covers only sections designed to avoid the necessity of latticing or battens, and tested with square ends. It has not been possible to consider the effect of different arrangements of the ends."

This action was based on the results of tests which revealed large and irregular variation in strength between columns of thin and thick metal. The committee found the variation to be caused by differences of quality in the steel not detected by the ordinary acceptance tests. The order for the steel specified a uniform material, and the tensile-test specifications allowed but a narrow range of variation. Yet the columns varied in ultimate strength between 21,000 and 38,600 lb. per sq.in.

In interpreting the test results, the committee does not accept the ultimate strength of a column as a measure of its service strength, but uses a new critical point, located somewhat lower but above the proportional limit, and calls it the "useful limit point." Working stresses and factors of safety are referred to this new point as defining the maximum available strength. In the whole series the "useful limit point" of the columns tested ranged from 18,500 to 35,000 lb. per sq.in.

The committee, formed in 1909, began its work by collating and diagramming all tests on columns over 5 sq.in. in area. It considered the results too erratic, and determined that new tests would be necessary. These were undertaken by the Government, through Dr. S. W. Stratton, Director of the Bureau of Standards, the large horizontal Emery testing machine of the bureau being used.

As the committee desired to determine the influence of cross-sectional shape on column strength, it eliminated interfering factors by making its test columns of solid-section types (without latticing or tieplates) and over-riveting them. The list of types included I-sections, box sections, built and rolled H-sections, Z-bar columns and bulb-angle columns. For each type "light" and "heavy" columns were provided, and for some types also "extra heavy," the differences being in thickness of metal only; they ranged from 8½ to 28½ sq.in. gross cross-sectional area. Each weight of each type was made in three lengths (ratio of length to least radius of gyration 50, 85 and 120). Some columns of length-ratios 155 and 20 were also tested, though the latter proved to act as short blocks, not as columns. Every test was made in triplicate. The total number of tests was 213.

The effect of duration of loading was tried out in a single test. A load of about 24,000 lb. per sq.in. was left on the column for 25 min.; a slight continued yielding resulted. Similarly, several higher stages of loading were applied continuously for periods of one-half hour to more than an hour, and in each instance continued yielding was recorded. The column failed at 28,720 lb. per sq.in. These results apparently were not thought significant, and the subject was not pursued further.

The ratios of length to radius of gyration above quoted are computed from the total length. The columns were tested between flat bearing surfaces, and before testing their ends were dressed true and square within 0.001 in.; thus they were fixed-end columns. Their deformation in the machine did in fact display two

Type.	Mill Specimen Tests made at Pittsburgh.			Bureau of Standards Specimen Tests.			Average U.L.P. of full-size columns $\frac{l}{r}$ = 50 and 85	Average ultimate strength of full-size columns $\frac{l}{r}$ = 50 and 85
	Average drop of beam.	Average ultimate strength	Number of tests.	Average U.L.P.	Average ultimate strength	Number of tests.		
1	34 000	56 900	7	33 100	59 000	8	28 300	32 000
1A	33 300	59 500	7	29 900	56 200	2	25 000	28 600
1B	36 400	59 600	4	31 100	57 000	1	26 200	27 700
2	36 500	57 700	5	32 500	58 800	8	28 100	32 900
2A	36 900	59 700	4	30 200	58 400	6	26 800	31 400
3	39 800	55 600	5	34 100	55 400	4	28 200	33 300
3A	37 900	59 200	2	.....	.....	.....	25 500	28 800
4	36 500	58 100	5	33 800	58 000	13	31 600	35 400
4A	37 700	59 400	4	27 100	59 700	13	22 900	27 900
5	.....	.....	.....	37 500	61 500	2	33 800	36 200
5A	.....	.....	.....	33 300	57 900	3	30 300	33 800
5B	.....	.....	.....	22 600	56 400	12	20 000	24 400
6	34 600	57 600	9	.....	.....	.....	24 500	30 400
6A	33 300	60 400	3	.....	.....	.....	22 600	29 500
7	34 600	59 400	5	33 500	61 600	3	30 000	32 500
8	39 200	56 300	6	.....	.....	.....	31 200	34 200
8A	37 600	58 700	3	.....	.....	.....	29 400	32 300
10	37 600	58 100	16	.....	.....	.....	26 800	34 000
10A	37 600	61 700	3	.....	.....	.....	25 200	30 100

COLUMN TESTS COMPARED WITH SPECIMEN TESTS MADE AT MILL AND AT BUREAU OF STANDARDS

points of deflection. For this reason test results and the committee's conclusions are restricted to columns which are fixed or have square bearing at the ends.

The steel ordered was identical with ordinary 60,000-lb. bridge steel, except for the greater uniformity required. The physical qualities specified were: Ultimate strength, 60,000 ± 1500 lb. per sq.in.; elastic limit, 38,000 ± 1000; elongation, 28% ± 2%; reduction of area, 56% ± 4%; bend test, 180° flat. The workmanship of the columns was well above commercial grade, the report states.

The results of the entire series of tests were tabulated in *Engineering News-Record*, June 28, 1917, p. 639. A greatly condensed summary is given in the table herewith, for comparison with the properties of the specimen tests.

Form of section has no influence on column strength, the committee early concluded: I-sections, box sections and the others could not be differentiated by their ultimate strength. It was originally thought that those cross-sections which have thin outstanding flanges would show a weakening due to early buckling of these flanges. However, no effect of the kind was noticeable, and similarly bulb-angle columns did not prove better than those built up of plain angles.

Nevertheless the wide variation of ultimate strength already mentioned was found. The last column of the table herewith shows some of this variation, although as each entry represents the average of six tests the individual variation is lost. "These extreme variations may be abnormal, but it must be remembered that the tests were made on material specially chosen and supposedly the best that the mills could produce."

The most significant differences are those between the light and the heavy columns of each type. The committee says:

"These records call attention to the decrease in unit ultimate strength of the heavy sections when compared with the light ones. . . . In seeking to account for the falling off in strength of the heavy material, the committee learned that it was necessary to look beyond the differences in the ratios of widths to thicknesses of outstanding legs and variations of cross-sections. The only remaining element which could be charged with responsibility appeared to be the metal itself, and though the intention had been to secure material of uniform grade a more careful and thorough investigation disclosed the fact that the attempt had not been successful. . . . In ordering the steel for the column tests, the committee provided for difference in working by allowing the mill to change the carbon content so as to endeavor to produce the same strength for the light material as for the heavy. . . . The complete record of the physical and chemical tests . . . gives no indication of the difference in strength between the heavy and light material. . . . The committee accepted some material which did not fully meet the rigid specifications, but it was considered at that time to be fully equal to, or better than, the ordinary grade of structural steel, which has an allowable variation of 5000 lb. per sq.in., more or less, from a desired ultimate strength of 60,000 lb. per sq.in.

"Tests of short columns . . . confirmed the belief that the strength of columns is governed not by the ultimate tensile strength of the material but by the point at which there is marked departure from an elastic condition."

The committee then declares that the yield-point recorded in ordinary tensile tests does not give a correct index of the strength of the material, even when the machine is run at comparatively slow speed, as at the Bureau of Standards. The conclusion is drawn that, in order to predict the strength of a column, *the nature of the metal must be determined by some other means than those generally used.*

In the endeavor to find a better criterion of metal quality, the committee selected a new point, above the limit of proportionality and below the commercial elas-

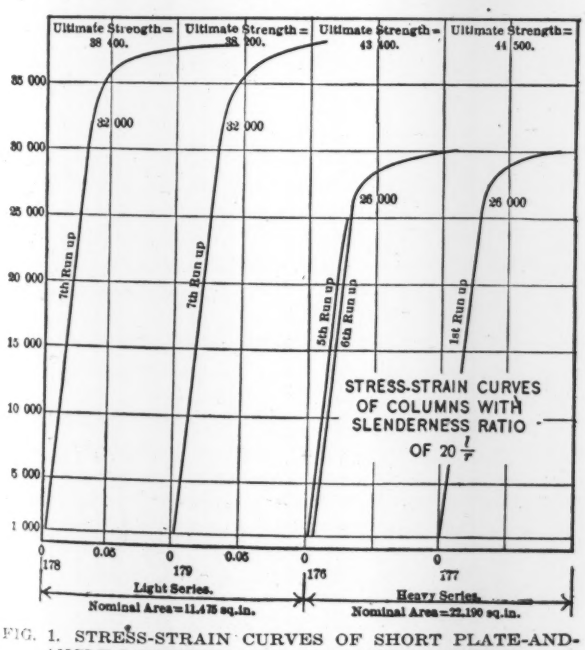


FIG. 1. STRESS-STRAIN CURVES OF SHORT PLATE-AND-ANGLE I-SECTION COLUMNS (TYPES 1 AND 1a)

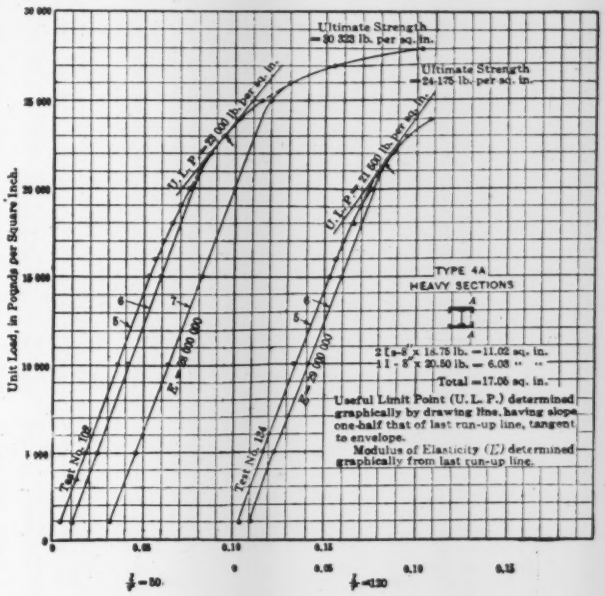

Ultimate Strength = 30 323 lb. per sq. in.
Ultimate Strength = 24 175 lb. per sq. in.
U. L. P. = 28 000 lb. per sq. in.
U. L. P. = 21 600 lb. per sq. in.
Unit Load, in Pounds per Square Inch.
TYPE 4A HEAVY SECTIONS
2 [8-8" x 18.75 lb. = 11.02 sq. in.
1 [- 8" x 20.50 lb. = 6.03 " "
Total = 17.05 sq. in.
Useful Limit Point (U. L. P.) determined graphically by drawing line having slope one-half that of last run-up line, tangent to envelope.
Modulus of Elasticity (E) determined graphically from last run-up line.
E = 28 000 000
E = 29 000 000
Test No. 128
Test No. 134
l/r = 30
l/r = 120

FIG. 2. "USEFUL-LIMIT POINT" USED TO DEFINE AVAILABLE STRENGTH OF COLUMN

tic limit or yield point. With one modification it is determined by a method suggested years ago by Prof. J. B. Johnson. The committee defines the critical point as "the point which is determined graphically by drawing a line tangent to the envelope of the stress-strain curve, having a slope of one-half that of the last run-up line for its straight or nearly straight portion." This point is to be called "useful limit point," and may be located in either a tension or a compression test.

The useful limit point exhibited by a small test-piece is a fairly reliable indicator of the strength of a large column, in the committee's opinion. Numerous specimen tests were made at the Bureau of Standards, in compression as well as in tension, and their useful limit points were compared with the figures obtained in the column tests. The conclusion is that (1) neither the yield-points nor the ultimate strengths of the small specimens bear any consistent relation to the ultimate strengths or the useful limit points of the columns, on the other hand (2) the useful limit points of the specimens bear a very definite and constant relation to the useful limit points of the columns.

As appears from this, not merely specimen tests but also the full-size column tests are to be judged according to their useful limit point; in other words, the ultimate strength of the column is not to be considered the maximum available strength as a basis for fixing working stresses. The committee says, "In straining a column there is a point beyond which its structural value is uncertain, and consequently unsafe to rely upon. This point lies somewhere above the region of perfect elasticity and well below the place where manifest yielding occurs. For the study of column tests, the useful limit point as above defined seems to fulfill these conditions satisfactorily." The stress-strain curves plotted from the column tests were found to have useful limit points generally 1000 to 2000 lb. per sq.in. lower than the ultimate strength of the column, but sometimes 5000 lb. and in one or two cases 10,000 lb. lower.

A plot of the useful limit points of the columns tested

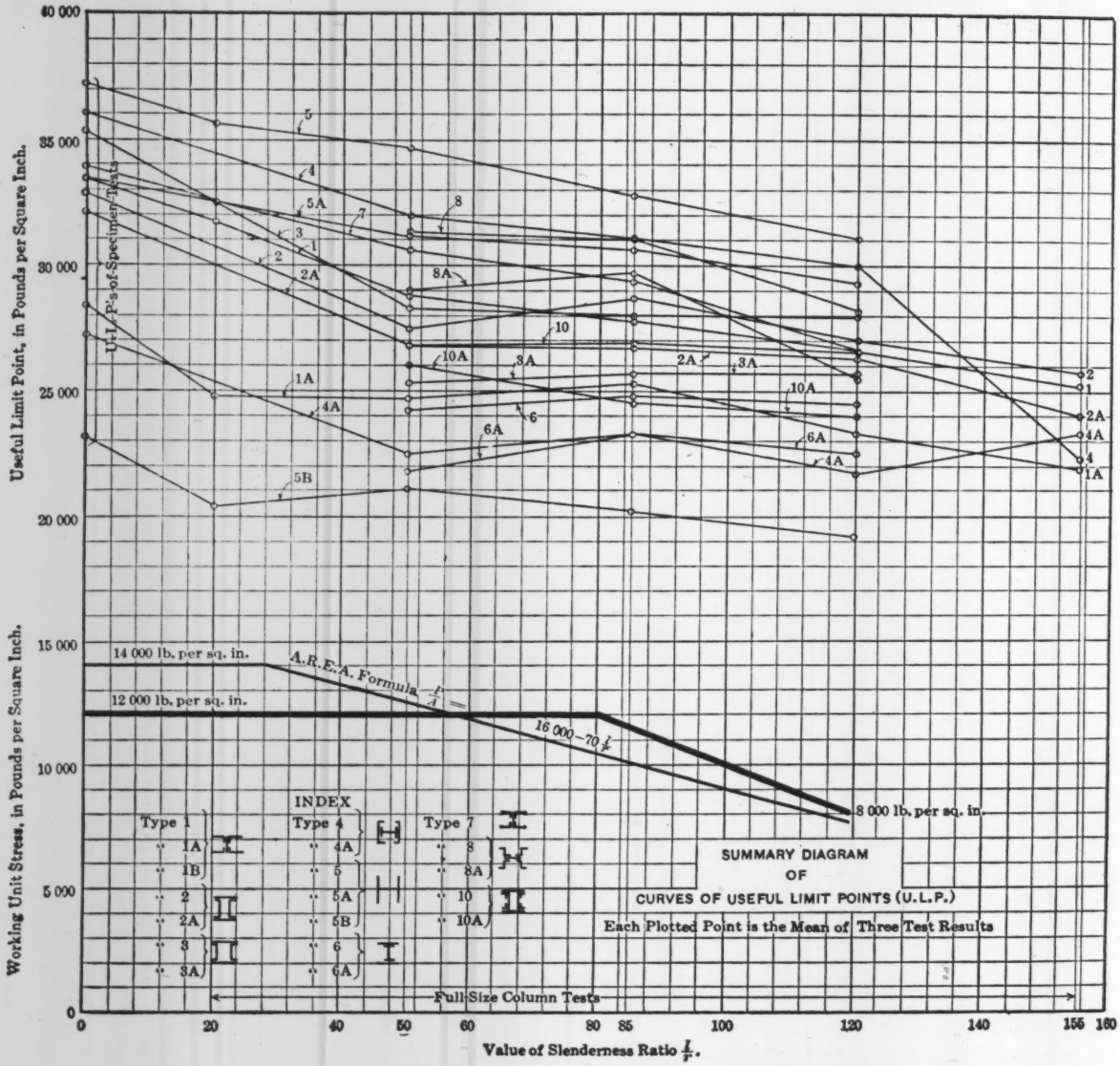


FIG. 3. GRAPHICAL CHART SHOWS THAT "USEFUL-LIMIT POINT OF FULL-SIZED COLUMNS VARIES SLIGHTLY WITH LENGTH-RATIO

is reproduced in the upper part of Fig. 3. In this are included the values for length-ratios of 20 and 155, although the text of the report attaches no great importance to these.

Working Stress for Columns Based on Useful Limit Point with Safety Factor of 2

The committee refers to the formerly current safety factor of 4 applied to ultimate strength of tension members, and says that this is equivalent to a factor of about 2 on the elastic limit. It holds that columns should have a factor of 2 based on the useful limit point, if they are to be as strong as tension members.

The average useful limit point of all the columns of slenderness-ratios 50 and 85 is 27,200 lb. per sq.in., and the lowest mean value of the entire series 19,700 lb. per sq.in. As the latter figure is 28% below the average, "it would seem to be necessary in recommending a working stress to assume a useful limit point lower than the average of all the tests. If we take as a safe assumption the mean between the lowest value and the average value, this mean will be 23,500 lb., or approximately 24,000 lb. per sq.in. The factor of 2 applied to 24,000 lb. will give a safe working value of 12,000 lb. per sq.in. for columns, which stress the committee would recommend. In this recommendation it is assumed that we are dealing only with static loads, and that a percentage of the static stress will be added to cover the impact due to moving loads. . . . The committee feels, in view of its studies in regard to the useful limit point, that there is no warrant for high working stresses in short columns."

The committee recommends using 12,000 lb. per sq.in. up to a slenderness ratio of 80, reducing from this point by a straight-line law to 8000 lb. per sq.in. for a ratio of 120, as represented by the heavy line in the lower part of Fig. 3. The limitation to square-end columns has already been quoted.

New Methods of Acceptance Testing Are Considered Necessary

Present steel-making processes do not produce a uniform material, says the committee, and present methods of testing do not give a correct indication of the compressive strength of the material. The suggestion is made that determination of useful limit point in specimen tests, whether tensile or compressive, would furnish a satisfactory indication of column strength, provided the specimens were selected so as to represent the average of flange and web of the section. While recognizing that careful selection of specimens and testing with extensometers, as required in determining the useful limit point, will make steel more expensive, it claims that the resultant saving and increased safety would warrant this extra cost.

At the time of its formation in 1909, the Special Committee on Steel Columns and Struts was headed by A. L. Bowman; L. D. Rights was secretary. Mr. Bowman and two members of the committee, A. P. Boller and Emil Gerber, have died. Three members resigned, R. P. Miller, F. C. Osborn and G. H. Pegram. The committee's membership during the past year consisted of James H. Edwards, C. W. Hudson (secretary), Charles F. Loweth, Ralph Modjeski, Lewis D. Rights (chairman), George F. Swain, Emil Swenson and J. R. Worcester. The final report, abstracted in the preceding, appears in the society's "Proceedings," December, 1917, pp. 2409-2459.

Heavy Fire Damage This Season in Pacific Coast Forests

MORE forest fires occurred on the Pacific Coast during the season of 1917 than in any year since 1910, according to reports recently given out by the U. S. Forest Service offices in Portland and San Francisco. Outstanding features of the fire season of 1917, in addition to the large number of fires, were the many fires caused by lightning and the heavy pall of smoke, which seriously interfered with the efficiency of the lookout system during the latter part of the season. Great difficulty was experienced in getting good men for fire-fighting work.

Approximately 1470 fires were handled in the district administered from the Portland office by forest service officers during the 1917 season. Of these 480 were seriously destructive. In Alaska the season was so wet that no serious fires occurred. In Oregon and Washington, on the other hand, the late and wet spring was followed by a period of dry weather which extended well into the fall and made conditions favorable for the start and rapid spread of fires. The cost of controlling and suppressing these fires in the district with headquarters at Portland was approximately $180,000, or $160,000 more than was spent in 1916.

Nearly 150,000 acres were burned over, which included privately owned timberland inside the national forests of the district. A large part of this was on old burns. A number of incendiary fires were believed to be of I. W. W. origin. In Oregon and Washington, at the peak of the season, the governor placed detachments of troops throughout the state, with orders to shoot anyone caught starting a forest fire. It is notable that this resulted in a sudden falling off in the number of fires reported. Six arrests were made for violation of the fire laws, and to date four convictions have been obtained. A severe electrical storm in the middle of July started more than 50 fires in the Crater, Umpqua and Cascade Forests. Most of these were promptly put under control, but because of the inaccessibility of the districts and the scarcity of firefighters a few developed into large fires.

In California 1500 forest fires occurred. Of these 150 were extensive and more than $100,000 was spent in extinguishing them. Between 15,000 and 18,000 acres of timberland were burned over, as well as a large amount of private property. In the Santa Barbara forest in June a total of 48,000 acres of brush-covered watersheds, chiefly within the forest, was destroyed, and a later fire in this same region burned over 10,000 acres. Fires in California resulting from lightning were more than ordinarily numerous this season, 500 being reported. As in past seasons, many fires resulted from the carelessness of settlers, campers and travelers who left unextinguished fires, and from the throwing of matches and burning tobacco from passing automobiles.

Make $35,000 Traffic Census in Chicago Loop

Maximum Hourly Record 1142 Vehicles—Double-Deck Street Will Separate Fast and Slow Traffic—Automobiles Are Used Mainly for Business

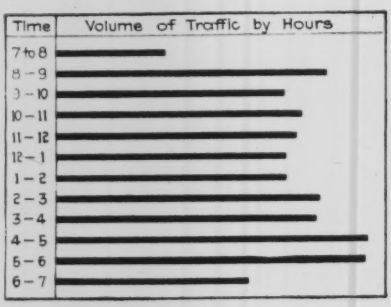
TRAFFIC counts of movements into, through and out of the central business district of Chicago were made in 1917 in connection with proposed street improvements which will facilitate traffic to a marked degree. Its main purpose was to show the relation of the traffic across Rush St. bridge over the Chicago River to conditions in the business district, and also to indicate what effect the widening and double-decking of Michigan Ave. at the river will have upon traffic conditions. The methods and results of this census are given in a paper read before the Western Society of Engineers by George C. D. Lenth, assistant chief engineer of sewers, Board of Local Improvements. The following information is an abstract of this paper.

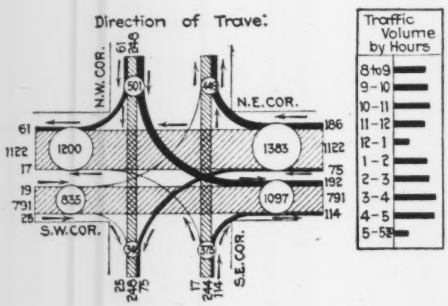
Most important of the improvements noted is the widening and extension of Michigan Ave. at the Chicago River for a connection with the north side boulevard system. The width of roadway at present is 75 ft., except that from Randolph St. to the river there is a "bottle-neck" with roadway only 38 ft. wide, and a street width of only 66 ft. A diagonal connection leads to the Rush St. bridge, which carries a dense traffic of automobiles and commercial vehicles. The improvement provides for widening this narrow stretch to 127 ft. and building a new bridge.

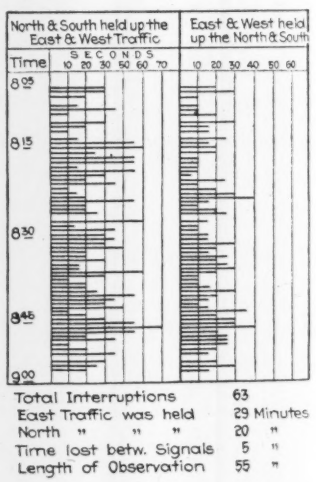
Both the street and bridge will be of double-deck construction, with the upper deck reserved for automobiles and the lower level for commercial vehicles. This will avoid the present serious interference and delays due to cross traffic at intersections and to the mixing of fast and slow traffic. As Michigan Ave. is a boulevard, the only commercial traffic permitted is that serving abutting property. There is, however, a large amount of such traffic crossing the avenue, and Rush St. bridge now carries both automobile and commercial traffic on the same roadways.

Traffic was divided into two classes for the purpose of this census: Self-propelled vehicles for carrying passengers only, and both self-propelled and horse-drawn vehicles used to carry freight. Count was made at six points on the south boundary of the business district, eight points on the west and five points on the north boundary.

A six-day count was made in June of all passenger automobiles entering and leaving the business district. Each vehicle entering was accounted for by noting its departure from or its location within the district. Each day the count was made continuously from 7 a.m. to 7 p.m. At the 18 "gateways" of the district






North & South held up the East & West Traffic
East & West held up the North & South
SECONDS
Time
8 05
8 15
8 30
8 45
9 00
Total Interruptions 63
East Traffic was held 29 Minutes
North " " " 20 "
Time lost betw. Signals 5 "
Length of Observation 55 "

GRAPHICAL REPRESENTATION BRINGS OUT CRITICAL CONDITIONS

AUTOMOBILES ENTERING AND DEPARTING FROM THE LOOP VIA NORTH SIDE BRIDGES OBSERVED BY HOURS, JUNE 27, 1916

	Rush St		State St		Dearborn St		Clark St		Wells St		Total North and South
Time	North	South	North	South	North	South	North	South	North	South	
7 to 8	120	360	11	2	*10	14	11	15	19	18	580
8–9	232	860	9	15	*35	60	29	40	110	*60	1,450
9–10	300	560	15	115	*30	16	30	55	36	81	1,238
10–11	420	620	19	13	*30	50	25	35	48	58	1,318
11–12	460	523	21	19	*40	53	46	42	44	64	1,312
12–1	647	249	14	9	*45	47	26	35	95	*75	1,242
1–2	468	440	29	16	36	40	55	*50	60	60	1,254
2–3	508	606	18	16	39	48	54	35	59	30	1,413
3–4	630	500	41	9	29	48	40	26	59	22	1,404
4–5	*700	598	74	16	47	56	46	36	60	60	1,693
5–6	667	500	80	22	92	56	120	24	69	46	1,676
6–7	517	254	35	7	51	36	53	24	51	26	1,054
12 hrs.	5,669	6,070	366	259	484	524	535	417	710	600	15,634

* Estimates.

COMMERCIAL TRAFFIC COUNT AT SOUTH WATER STREET AND MICHIGAN AVENUE FROM 8 A.M. TO 5:30 P.M., JULY 19, 1916

Time of	S. E. Cor.			N. W. Cor.			S. W. Cor.			N. E. Cor.			
Observation	N.	E.	W.	S.	E.	W.	E.	N.	S.	W.	N.	S.	Total by Hours
8 to 9	28	16	1	24	12	3	90	1	1	120	15	4	315
9–10	21	13	1	26	18	7	88	1	5	138	16	12	346
10–11	39	20	3	36	20	7	83	2		113	21	7	351
11–12	22	13	1	32	19	7	57	2	5	125	15	11	309
12–1	13	4	1	16	6	3	23	1		51	11	2	131
1–2	31	14	3	37	18	9	89	4	2	85	8	7	307
2–3	32	12		20	26	14	104	2	4	115	28	9	366
3–4	30	14	5	35	43	5	101	2	3	149	29	14	430
4–5	20	8	1	11	26	5	133		5	165	30	5	409
5–5:30	8	0	1	11	4	1	23	4		61	13	4	130
9½ hours	244	114	17	248	192	61	791	19	25	1,122	186	75	3,094

observers noted the license number and time of every car that passed. Other observers assigned to certain blocks or sections of the district made similar note at hourly intervals of the automobiles standing in these sections.

The purpose of this count was to ascertain the volume of traffic at all the bridges and entrance to the business district, its distribution over the district, and the daily fluctuating of traffic. The average number of vehicles counted daily was 49,590. Of these, 20,341 passed the south-side entrances, 15,634 passed the north-side entrances, and 13,615 passed the west-side entrances. The totals for one day are given in Table I. Similar count

TABLE I. TRAFFIC CENSUS OF AUTOMOBILES ENTERING AND LEAVING THE BUSINESS DISTRICT OF CHICAGO, JUNE 27, 1917, 7 A.M. TO 7 P.M.

	In	Out	Total	Per Cent. of Total
South Side:				
Michigan Ave	10,711	8,799	19,510	39 34
Wabash Ave	183	243	426	0 86
State St	67	51	118	0 24
Clark St	78	115	193	0 39
Fifth Ave	54	46	100	0 20
Indiana Ave	0	25	25	0 05
Total South Side	11,093	9,279	20,372	41 08
North Side (Bridges):				
Rush St	6,070	5,669	11,739	23 68
State St	259	366	625	1 25
Dearborn St	524	484	1,008	2 04
Clark St	417	535	952	1 43
Wells St	600	710	1,310	2 65
Total North Side	7,870	7,764	15,634	31 05
West Side (Bridges):				
Randolph St	141	237	378	0 76
Washington St	2,893	2,392	5,285	10 66
Madison St	400	479	879	1 78
Adams St	289	373	662	1 34
Jackson St	2,803	3,360	6,163	12 43
Van Buren St	36	52	88	0 17
Harrison St	54	51	105	0 22
Polk St	29	26	55	0 11
Total West Side	6,645	6,970	13,615	27 47
Grand total	25,608	24,013	49,621	99 60

made on a Sunday in July showed a total of 34,400 automobiles. The maximum hourly records are shown in Table II.

That the automobile is distinctly a business vehicle and not employed merely for pleasure is shown clearly by the records. Of 43,761 cars with Illinois licenses included in this count, 67.8 per cent. were used for business purposes. Rush St. bridge carried 45 per cent. of the above total, and 67.3 per cent. of these cars were for business use. Taking the records on all the automobiles using Rush St. bridge and Michigan Ave., as well as all the other gateways of the business district, it is shown that 85 per cent. of the daily use of the automobiles is for business purposes.

A three-day count covered all automobiles crossing Rush St. bridge, and the arrival and departure of automobiles at 105 of the principal hotels, theaters, restaurants and office buildings in the business district. Record was made of the license number, the number of passengers and the time. The purpose of this count was to show the relative use of the Rush St. bridge and its importance to owners and tenants in the business district. The count was made in June, and covered 15 hours each day.

On one day the number of automobiles going north over the bridge was 7723, or an average of 515 per hour, while the maximum hourly record was 959 vehicles between 5 and 6 p.m. Going south, there were 7278 automobiles, or an average of 485 per hour, with a maximum of 680 between 4 and 5 p.m. Of 869 automobiles, with 1613 passengers, which stopped at one hotel on one day, 196 automobiles, (22%) and 351 passengers (21%) used the Rush St. bridge. Similarly, of 61 automobiles, carrying 83 passengers, which stopped at a large office building, 34 automobiles (55%) with 45 passengers (54%) used this bridge.

TABLE II. MAXIMUM HOURLY RECORDS OF AUTOMOBILE TRAFFIC AT THE BOUNDARIES OF THE BUSINESS DISTRICT OF CHICAGO

		Number	Location	Time
South Side	In	1,142	Michigan Ave	4 to 5 p.m.
South Side	Out	1,028	Michigan Ave	4 to 5 p.m.
North Side	In	860	Rush St. Bridge	8 to 9 a.m.
North Side	Out	700	Rush St. Bridge	4 to 5 p.m.
West Side	In	440	Washington St.	10 to 11 a.m.
West Side	Out	540	Jackson St.	5 to 6 p.m.

Separation of the automobile and commercial traffic on Rush St. bridge and in Michigan Ave. is necessary in the solution of the traffic problem. This is shown by a three-day count of interruptions to automobile traffic by transverse movements on intersecting streets and by slow-moving vehicles traveling in the same direction as the automobiles. The purpose of this was to ascertain

Rush St. Bridge - Going North, June 26, 1916

HOUR	HOUR	HOUR
	5:12 P.M.	5:13 P.M.
1 17736	72049	8751
2 71341	64487	30586
3 42875	34447	153298
4 48108	Michigan	5872
5 21232	1643	81248
6 9569	19982	46905
7 15996	153659	33380
8 7215	56363	56417
9 13292	New Jersey	616
10 29154	60814	6283
11 67173	25292	85482
12 53550	4738	188509
13 Indiana	2682	94319
14 39508	129808	26189
15 11686	4946	178569
16 26696	75264	Wisconsin
17 34548	78317	30781
18 27762	51247	187606
19 171566	15365	81048
20 529	22541	20614

STATE OF ILLINOIS } SS:
COUNTY OF COOK }

E E Mahannah, being first duly sworn on oath says that he resides at 1405 E 57th St, Chicago, Illinois, and that on the 26th day of June, 1916, between the hours of 5:0 PM and 5:18 PM he counted all the automobile commercial vehicles passing north south over west at the intersection of Rush Street and Bridge Street, and that he also noted the license numbers attached to said vehicles and that the said count of vehicles and the said license numbers of the said vehicles were set down by him as above and are true and correct, and that said vehicles were all the vehicles of that character passing in that direction.

E E Mahannah

SUBSCRIBED AND SWORN to before me this 27 day of June A.D., 1916.

Notary Public

TRAFFIC RECORD KEPT BY LICENSE NUMBERS

the amount of commercial traffic across and along Michigan Ave. in relation to automobile traffic on Rush St. bridge and Michigan Ave. The count of cross traffic included all commercial vehicles, self-propelled and horse-drawn, but no automobiles.

Interruption of Traffic Enormous

In 9½ hours on one day 1200 commercial vehicles crossing Michigan Ave. interrupted the progress of 540 automobiles northbound and 261 southbound. At the same time 2079 commercial vehicles on the cross streets were interrupted by the automobile traffic. The interruptions averaged 57 per hour, with a maximum of 67 between 1 and 2 p.m. The count showed also 1500 commercial vehicles mixing with 13,000 automobiles. Traffic on Michigan Ave. was held up for two or three blocks whenever the cross traffic was given the right of way half a minute. In going from Randolph St. to Chicago Ave., 25 per cent. of the time was spent standing in Michigan Ave. on account of the cross traffic at that point.

Interruptions to automobile traffic on Michigan Ave. by commercial vehicles crossing it to serve the railway freight houses were the subject of a two-day count in February. Each covered the period between 7 a.m. and 6 p.m. The purpose was to show the benefit of separating the commercial and automobile traffic as contemplated by the double-deck improvement of Michigan Ave. At one freight house, 65 loaded and 212 empty vehicles arrived, and 253 loaded and 73 empty vehicles departed. The loaded vehicles carried only package freight. Coal and fruit form the largest proportion of traffic in this district.

Organization for Traffic Census

Study of the traffic problem in relation to the Michigan Ave. improvement was assigned to a committee of four members. For observers there were chosen 250 juniors and seniors from the University of Chicago, all of whom were studying economic conditions. They were carefully trained, and were paid $5 per 12-hour day. Relief squads were arranged so that the work of keeping count could proceed continuously. The count was recorded in field books, a sample page of which is shown in one of the drawings that are reproduced herewith.

For the count of heavy traffic on Michigan Ave. at 12th St., there were 16 men, 8 on duty at a time. By consent of the South Park Commissioners, two automobiles were stationed in the center of the north-bound and south-bound roadways respectively, and facing against the traffic. Thus all automobiles passing this point had to pass on one or the other side of the stationary cars. In each car were four men; one called the number of each passing car, the second recorded it, and the third called the time. The fourth man acted as a relief. The volume of traffic at this point is indicated by the maximum record of 1350 cars in one direction in one hour.

Six or eight men were stationed at other points, and in some cases only two men. Frequently there were four men, taking traffic in opposite directions so as to avoid confusion. The observer called to the recorder the license number of the car, or the name of the state for foreign cars. He also called the time at intervals of about five minutes, depending on the volume of traffic. For counting the cars standing in the district, each block was given a number and an observer made hourly trips over each block. These men recorded time intervals and the license numbers of the automobiles within the block during each interval.

At the end of each day's work the observers reported at the office and made affidavit as to the correctness of their work. The books were then turned over to the clerical staff of about 60 men. The information in the books was entered on ledger cards, 5 x 8 in., one for each automobile having an Illinois license number. The name and address of the owner were entered, being obtained from the monthly lists issued by the Secretary of State. The card contained the time and place of each observation on that particular car, the locations when standing being marked in red and those when moving in black. The six-day count described above included 43,761 Illinois automobiles, and their movements were recorded on 74,000 cards.

Concrete Casing of Wood Piles Fails in Driving

CASING wood piles with concrete as a protection against marine borers proved unsuccessful in recent experiments on the Illinois Central R.R., as the casing stripped off when the piles were driven. The test piles had a drift bolt driven in each end, and for applying the casing they were placed horizontally in a rack, being supported by the bolts. Expanded metal was then wrapped around the pile and nailed in place, but kept about ¾ in. clear of the wood. This wrapping began at 4 ft. from the butt and extended for a length of 12 ft. Expanded metal of ¾-in. to 2½-in. mesh was used on different piles. After wetting the piles, a concrete coating was applied; and was left on for an hour, when it was wetted and a second coat applied. The thickness was from ¾ in. on the smaller mesh to 1¾ in. on the larger mesh. The piles were kept covered from the sun, and were wetted every two or three days for a period of three weeks.

WHAT DRIVING DID TO A CONCRETE-CASED WOOD PILE

In driving the piles with a steam hammer the friction of the ground held the concrete and the wood pile was driven down through its casing, tearing and splitting the expanded metal and the concrete shell.

Capacity of Toronto Refuse Destructor Exceeds Contract Provision

Top-Fed 180-Ton Plant Burns 400 Tons a Day, Making It Possible to Change to Two-Shift Operation—Has Charging Containers Operated by Hydraulic Rams, Clinker Cars and Elevator, and Recording Instruments

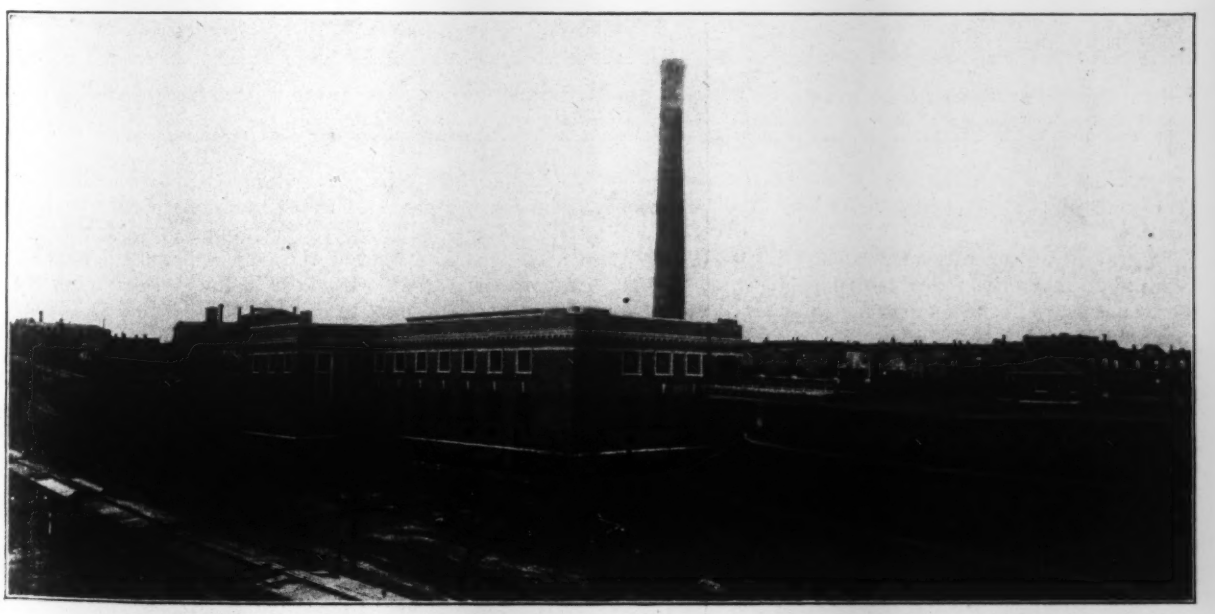
By I. S. Osborn
Consulting Engineer, Cleveland, Ohio.

THE completion and test of the Don Roadway refuse destructor at Toronto, Ont., marks an interesting point in the carefully proposed refuse-disposal program of that city. The destructor is of the Sterling type, with a contract capacity of 180 tons a day and a test capacity of 400 tons. Arrangements for charging the destructor and for removing the clinker, as well as for recording the temperature, and other recording devices for the plant, are unusually complete.

Toronto has numerous deep ravines and considerable low-water frontage on Lake Ontario and its bays. These areas in the past have served for dumping grounds, thus reclaiming these lands and at the same time disposing of the refuse. A portion of the refuse was burned in two old crematories. Several years ago it was apparent that the available dumps for garbage and refuse would soon be filled and that provision must be made for adequate disposal of this refuse. A report on the conditions was prepared and estimates were submitted for several methods of disposal. A by-law was passed at a general election appropriating $1,000,000 for the work. The project then lay dormant until 1914 when, after a thorough survey, plans and specifications for refuse disposal were prepared. These plans called for the separate collection of garbage, rubbish and household ashes. The garbage was to be treated in a reduction plant built and operated by the city; the rubbish was to be burned in several incinerators located with special reference to economical collection; and the use of the household ashes for filling low land was to be continued. Householders objected to the separation of kitchen garbage and combustible rubbish by themselves. The council therefore directed the street cleaning department to provide for the incineration of the mixed garbage and refuse.

It was decided to build three modern high-temperature destructors and one low-temperature crematory. One of the high-temperature destructors was to be located in the eastern part of the city, one in the northern part and one near the site of the old crematory at the cattle market in the western part. The low-temperature crematory was to be built on Centre Island, replacing the old furnace there, which burned the refuse and night soil from the summer colony on the islands in Toronto Harbor. The eastern destructor was to be built first. The cattle market crematory was to be kept in operation until it was replaced by a modern destructor. The department therefore let the contract for the crematory at the Island, to be built in accordance with the plans prepared by them. The description of this crematory is given later. The old crematory at the cattle market was repaired and kept in operation. Specifications were drawn and the contract let Apr. 20, 1915, for the construction of the first destructor.

During the preliminary work careful analyses were



THE TORONTO REFUSE DESTRUCTOR IS HOUSED IN A BUILDING OF GOOD ARCHITECTURAL APPEARANCE
At the right the weigh house and one of the two reinforced-concrete bridges are shown. Note proximity of large hospital and workhouse

made of the character of the refuse to be handled, and surveys were conducted to determine the tonnage to be burned by the various plants. During October, 1914, representative samples were taken from numerous collection wagons from all sections of the city. (See table.)

A sample containing the stated amounts of the various constituents showed 25.99% of combustible matter, 47.66% of moisture and 26.35% of ash and residue and also the following calorific values in B.t.u. per lb.: Original sample, 2572; dry sample, 4914; combustible, 9897.

With the information obtained from these analyses the specifications were drawn requiring the destructor furnaces to burn, without the use of additional fuel, mixed refuse containing not over 940 lb. of water per ton and not less than 460 lb. of combustible—that is, 47% moisture, 23% combustible, and 30% non-combustible.

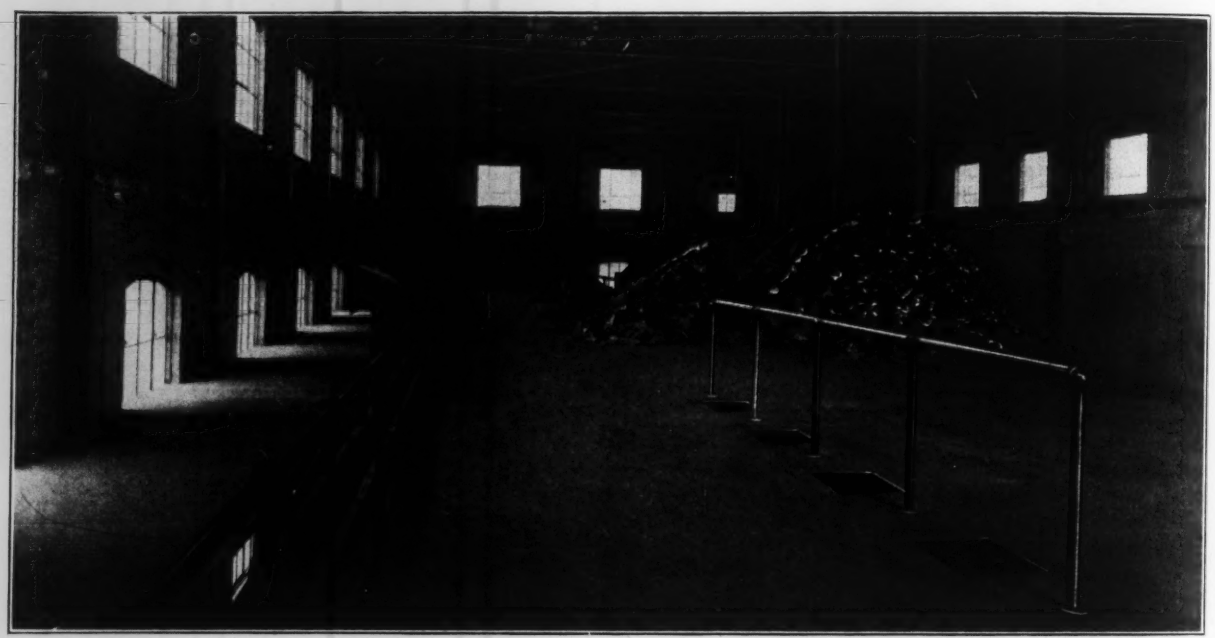
To prevent nuisance from the plant the bidders were required to make the following guarantees: (1) That the temperature in the combustion chamber of each furnace would not fall below 1250° F. for more than three minutes in any one hour. (2) That the average temperature would be at least 1400° F. (3) That the gases of combustion from the chimney would not be of a degree of darkness or density greater than chart No. 1 of Ringleman's smoke scale. (4) That the residue of the furnaces would not contain more than 1% organic matter exclusive of carbon. (5) That no dust should be emitted from the chimney. The operation of the plant in accordance with the above guarantees would insure absolute freedom from nuisance of smell or smoke in the neighborhood.

A site was selected on city property at the corner of Wilton Ave. and the Don Roadway, adjacent to two broad east and west highways and one north and south highway. The building was located in the valley a few feet above the level of the Don River, while the grade of the adjacent streets is about 30 ft. higher, thus giving a level approach for the collection wagons from the street to the upper receiving floor of the building. Particular attention was given to designing an attractive building and to improving the appearance of the surroundings.

The guaranteed capacity of the plant is 180 tons of mixed refuse per day of 24 hr. The estimated eventual tonnage to be burned was 120 tons. The plant was therefore laid out with three furnace units, one of which was to be kept in reserve.

The operation of the plant is as follows: The collection wagons and carts drive into the plant from Wilton Ave., stopping to be weighed on a platform scale. The beam for this scale is located in a weigh house of brick with a Spanish tile roof, which also serves for the office of the superintendent of the plant. From the scale the wagons enter the tipping floor of the main building over a reinforced-concrete bridge 22½ ft. wide and 57 ft. long, paved with creosoted wood block and provided with heavy concrete wheel guards and iron hand rails.

The large area of the tipping floor is an innovation in municipal refuse plants. There is a clear wagon space 150 x 35 ft., paved with wood blocks. The ample width permits the passage of wagons from the entrance to the exit when other wagons are backed up to discharge their loads. As many as 15 carts and wagons have been seen on this floor at once, with seven discharging their loads simultaneously. The ample turning and unloading space for the wagons prevents loss of time in their collection service, and also prevents a long unsightly line of wagons standing on the street awaiting their turn to enter the building. The exit for the wagons is at the



DESTRUCTOR CHARGING FLOOR HAS AMPLE ROOM FOR STORING REFUSE BACK OF CONTAINER-CHARGING HOLES

Roomy wagon floor on higher level at right. Roof trusses are provided with gusset plates for supporting overhead traveling cranes with grab buckets, but at present hand charging of containers is used. The containers are below holes in charging floor

north end of the building, over a bridge 135 ft. long, similar to the entrance bridge.

The wagons discharge by tipping onto a lower storage and feeding floor 141 ft. long, and 20 ft. wide to the charging containers. The refuse can be stored the full length and to a depth of 9 ft. at the rear, giving a capacity of about 585 cu.yd. This storage capacity is provided so that sufficient material can be stored to operate the furnaces at full capacity for 24 hr., although the wagons come to the plant at about the same hours each day. This large storage also accommodates the fluctuations in quantity which invariably occur on the different days of the week.

The plant was laid out and designed with the intention of feeding the refuse from this storage bin into the furnaces by means of a grab-bucket operated by an overhead electric traveling crane. It was so designed that the refuse could be charged into the furnaces by hand at times when the crane was not in operation. This provision would prevent shutdown of the plant for any minor defect of the crane or electric service. The installation of this crane was not part of the original contract. The city decided to try feeding the furnaces by hand, and to install a crane at a later date if considered advisable.

The refuse is charged into the furnaces by means of charging containers or hoppers which make each charge

MECHANICAL ANALYSIS OF 21,034 LB. OF TORONTO REFUSE COLLECTED FROM ALL PARTS OF THE CITY, OCTOBER, 1914

Classification	Weight Lb.	Weight Per Cent.	Volume Cu.Ft.	Volume Per Cent.	Pounds per Cu.Ft.
Glass and crockery	771.25	3.52	22.30	1.90	28.2
Metals	81.50	0.40	7.50	0.52	10.9
Paper and cardboard	4,653.00	22.12	682.40	47.58	6.8
Tins	398.25	1.90	49.55	3.47	8.0
Rags	420.75	2.01	42.53	2.98	9.9
Bones	150.00	0.72	4.70	0.33	31.9
Vegetable matter	10,185.00	48.53	390.72	27.21	26.1
Bread	156.75	0.75	11.06	0.89	14.1
Fish	240.50	1.15	6.10	0.41	39.4
Wood, boxes and baskets	235.50	1.12	40.60	2.89	5.8
Linoleum	113.25	0.54	17.29	1.27	6.6
Grass, flowers and weeds	187.75	0.89	25.91	1.80	7.2
Shoes	92.50	0.44	6.66	0.48	13.9
Sawdust and dirt	2,196.00	10.44	66.79	4.66	32.8
Ashes	1,079.00	5.13	31.20	2.18	34.6
Excelsior, straw	73.00	0.34	20.46	1.43	3.6
Total	21,034.00	100.00	1,430.77	100.00	

of a definite volume, to prevent overloading the furnaces. Each furnace cell is charged in rotation at regular intervals. These containers are operated by low-pressure hydraulic rams which are controlled either by the firemen on the stoking floor or from the furnace tops. The openings in the furnace arches are closed with a slow-moving massive firebrick-lined cover, which seats, gas tight, on a heavy cast-iron frame. A quick-acting pair of hinged steel doors actuated by a link motion holds the refuse in the containers, dropping the charge after the big door has opened. These steel doors close quickly after the charge has dropped, preventing a backlash from the furnaces and an inrush of an excessive quantity of cold air.

The furnaces consist of three Sterling destructor units arranged in a row. Each unit has four cells with drying hearths and a common combustion chamber. Stationary grates with proper air space for forced draft are used. The firebrick lining around the grates is protected from damage from the fire tools, or from the adhesion of clinker, by a system of massive hollow air-cooled castings cooled by the forced draft from the ash pits. The furnaces are cleaned through large guillotine doors, each held, with a gas-tight fit, against the furnace fronts by eccentric clamps. The furnaces are stayed with steel buckstays. The thrust of all arches in the furnaces, combustion chambers and flues is resisted by cast-iron or steel skewbacks which in turn transmit their thrust to vertical buckstays. The guillotine doors are each provided with a dwarf stoking door at a convenient height, so that the operators will work in a natural and easy position while stoking and spreading the refuse on the fires.

Forced draft is provided for each unit by a steel-plate exhauster fan driven by a direct-connected electric motor. The air for this forced draft is drawn from hoods built over each furnace front, thus exhausting the dust arising during the cleaning periods and also cooling the operating space in front of the furnaces. The air is forced from the fan through a regenerator, or air heater, built up of cast-iron tubes packed into sectional cast-iron tube sheets. A bypass flue is provided so that all or part of the flue gases can be sent through the regenerator to preheat the forced draft. Suitable means is provided for regulating the amount and temperature of the flue gases to be diverted through the regenerator. The forced draft is then taken through a duct to the ashpits. Each ashpit is provided with a damper to regulate the amount of forced draft for each individual cell.

The flues from the furnaces to the chimney are elevated on structural steel supports so that it is possible to utilize a large portion of the area of the lower floor for the storage of motor trucks, wagons and other departmental equipment. The flues are provided with numerous refractory-line cleanout doors. Between the

TEST RESULTS OF STERLING REFUSE DESTRUCTOR AT TORONTO, ONT., JUNE, 1917

	June 26th	June 28th
Outside temperature, F°, max	65	69
Outside temperature, F°, min	56	55
Barometer, in	29.61	29.71
Humidity, %	95	56
Rainfall, in	0.4	
Furnace units tested, Nos	No. 1 and No. 2	No. 2 and No. 3
Total refuse consumed, tons	88.82	57.17
Time, hr. and min	8-0	4-55
Number charges burned	No. 1—262	No. 2—228
Number charges burned	No. 2—256	No. 3—280
Number charges burned, total	518	508
Weight per charge, lb	343	225
Moisture, %	63	51.5
Combustible, %	20.6	28.35
Residue, %	16.4	20.15
Moisture per ton refuse, lb	1,260	1,030
Combustible per ton refuse, lb	412.0	567
Clinker and ash ton refuse, lb	317.0	403
Dust in combustion chamber and flues, lb	11.0	
Average time between clinkering, hr and min	4—0	3—16
Temperature combustion chamber, F. °, max	No. 1—2,275	No. 2—2,325
	No. 2—1,900*	No. 3—2,275
Temperature combustion chamber, F°, min	No. 1—875	No. 2—1,350†
	No. 2—925	No. 3—1,400
Temperage combustion chamber, F°, av	No. 1—1,476	No. 2—1,920
	No. 2—1,440	No. 3—1,950
Air pressure in ash pits, av., in	No. 1—0.81	No. 2—0.87
	No. 2—0.52	No. 3—0.847
Air pressure at regenerator, av., in	No. 1—2.7	No. 2—1.9
	No. 2—1.63	No. 3—2.6
Temperature air at regenerator, av., F°	No. 1—221	No. 2—303
	No. 2—226	No. 3—300.4
Temperature air at regenerator, max., F°	No. 1—345	
	No. 2—300	
Average draft in flue bypass, in	No. 1—0.7	No. 2—0.49
	No. 2—0.6	No. 3—0.5
Chimney temperature, F°, max	1,015	1,100
Chimney temperature, F°, min	725	950
Chimney temperature, F°, av	859	1,020
Chimney pull av., in	1.5	1.58
Electric current per ton refuse, kw	2.82	2.72
Refuse burned per hr. per furnace, tons	5.55	5.83
Refuse burned per hr. per sq.ft. grate surface, lb	111	116.5
Exceeding guarantee, %	122	133
Labor per ton refuse, man-hr., operating furnaces only	0.45	0.428
Total labor per ton refuse, including firemen, chargers, clinkerman, supervisor, wagonman, and weighmaster, man-hr	1.67	1.59
Tons refuse per man-hr., furnaces only	2.22	2.34
Tons refuse per man-hr., total	0.598	0.628
Maximum CO_2, %		9.5

* June 26 hyrdoelectric power off 45 min.; temperature of combustion chamber dropped.

† June 28, minimum temperature combustion chamber at time of starting.

main flue and the chimney, a large gravity dust catcher is installed which effectually extracts the small proportion of dust which is not caught in the combustion chambers. The flues are lined throughout with 9 in. of firebrick backed by common brick and faced with salt-glazed brick. The furnace and the combustion chamber are also faced with salt-glazed brick, which gives a pleasing finish and to which dust does not readily adhere. A large counterbalanced damper is placed in the flue between the dust catcher and the chimney to prevent emission of dust from the chimney top when the dust catcher is being emptied.

The chimney is built of red radial brick lined to the top with a self-supporting firebrick lining. It is 175 ft. high above the foundations with a clear internal diameter at the top of 90 in. It is provided with a lightning rod and an external ladder. The chimney was built by the Canadian Custodis Chimney Company.

The clinker and ash, when drawn from the furnace cells, drop through trap doors in the stoking floor into steel cars in the ash run on the floor below. The cars have side dumping steel bodies of 1½ cu.yd. capacity. The trucks have roller bushed wheels. The cars are run by hand on an industrial track which slopes downward to an automatic elevator which raises them to the level of the top of the clinker bin, in a wing of the main destructor building. The bin has a capacity of about 115 cu.yd. It is built of steel, lined with reinforced concrete which has tile embedded in its face. The lining prevents damage to the steel bin from the heat of the clinker and also gives a smooth surface to the inclined bottom of the V-shaped bin to lower the frictional resistance when the bin is being emptied. The clinker bin is discharged by means of counterbalanced steel chutes similar to a coal pocket. A railroad siding is provided below this bin so that the clinker can be removed either in gondola railroad cars or by wagons.

Electric pyrometers installed in the combustion chamber of each furnace unit record the temperature of each combustion chamber once a minute on a chart installed in the foreman's room. A CO_2 recorder analyzes and records the percentage of CO_2 in the flue gases. Thermometers indicate the chimney temperature and the temperature of the preheated forced draft. Air gages show the pressures in the ashpits, in the forced draft ducts, in the flues, and at the base of the chimney.

The building is built of red face brick with courses of black header brick. The trim for the windows, doors and corners is white cut stone. The windows have ventilated steel sash glazed with opaque wire glass. The roof is of tar and gravel on concrete supported by steel trusses. The building steel work was designed with sufficient strength and rigidity to carry electric cranes if it should be found desirable to install them. A ventilating louver is provided on the roof, extending the whole length of the building, the sides of which are fitted with steel shutters operated from the charging floor. On the ground floor the mess room for the operators is fur-

THE DESTRUCTOR PLANT CONSISTS OF THREE UNITS OF FOUR CELLS EACH

Furnace fronts, showing ventilating hoods, charging control levers, salt-glazed face brick, heavy steel buckstays, stoking doors at convenient level, ash-and-clinker doors, and trap doors in front of the latter for dropping clinker to cars on track beneath

nished with long tables and benches and woven wire ventilated steel lockers. The foremen have a separate room and there is a storeroom for housing sundry supplies. All of the floors are inclined and guttered for quick drainage to facilitate cleaning and flushing. Numerous hose connections are conveniently distributed throughout the building. Standard fire hose and connections are provided at the storage bin. The entire building is brilliantly illuminated by clusters of electric filament lamps provided with metal reflectors.

After the completion of construction the contractors were required to dry out the furnace brickwork thoroughly, then to instruct the operators in firing the furnaces. After this a 30-day test was run, beginning Apr. 16 and continuing night and day until May 19, 1917. This test was to demonstrate that the furnaces could burn the specified tonnage of ordinary refuse without nuisance. During this period the moisture in the refuse ran as high as 57.8%. The residue averaged 21.4%. The heats obtained were not only sufficiently high to prevent nuisance from smell, but it was even frequently necessary to open the bypass flues and adjusting devices to prevent the furnace temperature from becoming too high. The tonnages burned ran considerably above the guarantees, the rate of burning reaching 77 lb. per sq.ft. of grate surface per hour.

After the completion of this 30-day service test, two special tests were required, burning refuse as near to the specified mixture as possible. The furnaces were started up cold and brought up to heat by burning refuse without using any kind of fuel. The furnaces burned so much more rapidly than the guaranteed rate of burning that it was difficult to accumulate sufficient refuse for a long test. The results of these tests fully demonstrated the ability of the furnaces to comply with or exceed the guarantees.

The 30-day service test and the two special tests showed that while the plant was guaranteed to burn 180 tons in 24 hours, yet it actually burned at the rate of over 400 tons in 24 hours. The collection system was considerably rearranged so that many more wagons could discharge their loads at the incinerator. After the city had accepted the plant and relieved the contractors of its operation, the night shift was laid off and the three furnaces were operated in the day time only. By rearranging the working hours to prevent lost time while waiting for refuse, and operating continuously over the noon hour, it has been possible for the city to burn over 142 tons in nine hours on three furnaces, when it was expected to burn 120 tons in 24 hours in two furnaces.

In 1915 a contract was let for a low-temperature crematory to be built on Centre Island to replace the old crematory which had been in use there for many years. This crematory is to destroy the refuse from summer cottages and picnickers at the Island. It is also designed to burn the night soil collected, as there is no sewerage system on these islands. The capacity of the plant is 20 tons of refuse and night soil in 24 hours. At certain periods it is necessary to burn coal to supply sufficient heat to evaporate the night soil. The building is of buff brick, with Spanish tile roof. The chimney is radial brick, 50 ft. high, lined to the top with firebrick and provided with lightning rods. The refuse is taken to the plant in rectangular cans, being conveyed from collection wagons to the plant on scows towed by a gasoline tug. The cans are unloaded from the scows on to a car which runs on an industrial track, on the wharf.

This car is pushed into the building on to an electric elevator. The car and cans are then raised to the level of the furnace top, and the cans are emptied into the charging holes of the furnace. The furnace is built with secondary firebrick drying arches over the main cast-iron burning grates. It operates under natural draft. The department has also built at the rear of the crematory a stable for housing the collection equipment at the island. The same style of architecture is followed, giving the entire plant a very creditable appearance.

The old crematory at the cattle market is still in use, although the department plans to replace this with a modern high-temperature destructor. This crematory is built in two furnace units, housed in a galvanized-iron building. It has done excellent service for many years, and during certain seasons of the year, when the refuse is comparatively dry, gives very little cause for complaint from nuisance. Its situation in the packing house district and near the new municipal abattoir, together with the fact that the neighborhood has been accustomed to it for many years, makes it possible to continue burning a large tonnage at comparatively low temperature without complaint.

The plant was built under the direction of George B. Wilson, commissioner of street cleaning, with the writer as consulting engineer. The Canadian Griscom-Russell Co., Montreal, P. Q., built the furnaces. The other work was done by Toronto contractors.

Inverted Transit Attached to Tunnel Roof

Giving of line and grade in 7-ft. tunnels constructed for the Edison Illuminating Co. of Boston was accomplished by means of transit attached to the roof of the tunnel in inverted position. Henry B. Pratt describes the method in the November "Journal of the Boston Society of Civil Engineers." The importance of keeping the muck-cars moving while the survey work was going on led to the unusual procedure.

The transit was screwed to a regular metal screw base, fastened to a wooden block about 8 in. square built into the roof of the tunnel; such a block was set about every 200 ft. along the tunnel. With the transit attached to this base, the clearance between the top of a car and the lowest part of the transit was about a foot. There was a 180° vertical arc on the transit, and the telescope bubble tube was inverted to bring the reading side up, so that the level could be centered when the vertical arc was in normal position.

Setting the instrument to line was easily done on the shifting head. In leveling, the height of instrument at a given station when once determined could be used as the basis for working from that point at subsequent setups. The tunnel being straight, no angles had to be read, which, Mr. Pratt says, might have proved a bothersome problem. The two plates of the transit were clamped, to prevent dirt working into the joint between them, and the joint was further protected by an application of heavy grease.

Ice Forming in Clay Soils Will Lift Surface Weights

But Tests Show That Freezing in Sandy Soils Will Cause Crystals That Do Not Affect the Surface

By Stephen Taber
State Geologist and Professor of Geology, University of South Carolina, Columbia, S. C.

AN INTERESTING illustration of the enormous force that may be developed as a result of freezing is given by H. J. Gilkey in his article, "Freezing Ground Acts Like Hydraulic Jack," in *Engineering News-Record* of Aug. 23, 1917, p. 360. Mr. Gilkey states that in a Middle West city 16-ton concrete piers resting on "solid blue clay" were elevated 3 in. during the unusually severe winter of 1916-17, and that subsequently they settled back to their original elevation. He explains that frost could not have penetrated more than from 6 in. to 1 ft. below the bottom of the piers, and that the expansion due to freezing of this depth of water would be insufficient to account for their elevation. This fact leads him to attribute the lifting of the piers to hydraulic pressure resulting from the progressive freezing of the ground from the surface downward.

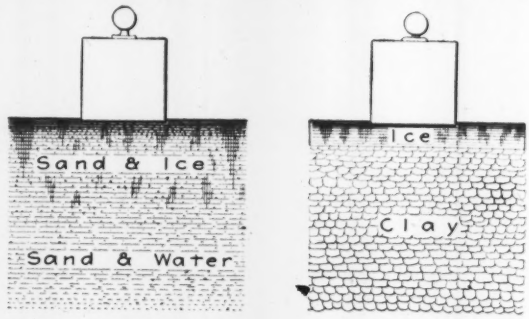
The theory suggested by Mr. Gilkey seems inadequate, however, to explain all of the facts. The piers project several inches above the ground, and concrete has a higher specific gravity than soil; therefore, if there were any hydraulic pressure, we would expect the frozen crust of the earth to be forced up rather than the piers. Moreover, if the clay was in such a semifluid condition as to transmit pressure in the manner postulated, there would certainly have been considerable differential settling of the piers.

Similar occurrences are by no means uncommon in cold climates, and their correct explanation is of some importance to engineers, as precautionary measures are apt to be of little value unless the cause of the trouble is thoroughly understood. During the past few years the writer has been conducting a series of experiments for the purpose of determining the conditions under which growing crystals may exert pressure against other solid bodies, and some of the results obtained have a direct bearing on this as well as on several other engineering problems. A brief summary of the conclusions reached as a result of the experiments was given in a paper on "Pressure Phenomena Accompanying the Growth of Crystals," printed in the "Proceedings" of the National Academy of Sciences, Vol. 3, pp. 297-302, April, 1917, and later republished in "Scientific American Supplement" for June 30, 1917, pp. 410-411.

In the course of some of the writer's experiments, carried out on cold nights, weights placed on wet clay were lifted through the gradual formation of virtually pure ice between the weights and the clay. Weights that were similarly placed on wet sand were not lifted, or at least their elevation was imperceptible, and no pure ice was formed under the weights, although the water occupying the interstices between the sand grains was frozen.

Water in extremely small capillary spaces remains in a liquid state at temperatures much below freezing. Most of the interstices in clay are in the form of very small capillary spaces, while in sand they are much larger. Therefore, the interstitial water freezes much more readily in sand than in clay.

In the experiments referred to above, the weights cooled off rapidly, thus chilling the film of water in contact with their lower surfaces until ice began to form. Where the weights rested on wet sand, freezing gradually continued downward, thus firmly cementing the sand grains together. (Cut at left.) The grains of sand were slightly separated in places as a result of the freezing, but the total elevation of the mass was so slight as to be imperceptible. Where the weights rested on wet clay, however, the ice forming at the surface gradually increased in thickness because of the freezing



ICE FORMING IN SAND WITH NO NOTICEABLE ELEVATION OF WEIGHT

ICE FORMING ON THE TOP OF WET CLAY AND RAISING A WEIGHT

of additional water that slowly reached the surface of the clay through the small capillary openings. (Cut at right.) Because of its manner of growth the ice had a fibrous texture, and as additions were made to its lower surface the ice was slowly elevated, together with any weights resting upon it.

The ice columns, or "needle ice," formed on bare clayey soils are familiar to most people living in regions where the nights are cold enough for heavy frosts. These ice columns, which commonly support sand grains, pebbles and sometimes larger objects, are formed in the manner explained above; and all of the facts cited by Mr. Gilkey indicate that the elevation of the concrete piers was probably due to this same process. If the piers had rested on sand instead of clay it is improbable that any elevation would have been noticed, no matter how thoroughly saturated with water the ground may have been.

The elevation of the weights in the writer's experiments is not to be explained by attributing it to the expansion in volume, which occurs when water freezes to form ice, for the distance through which the weights were lifted was approximately equal to the total thickness of the ice. The lifting of the weights was due to the growth of the ice crystals, and this would continue in spite of the pressure as long as water was available for growth and the temperature was low enough to cause freezing. With any increase in pressure, however, a lower temperature would be required in order that freezing should continue, for the melting point of ice is raised by increasing the pressure or in any way placing the ice under additional strain.

Similar pressure effects were obtained in other experiments through the crystallization of several different kinds of salts from supersaturated solutions, and it

was proved that growing crystals could exert pressure against other solids even when the crystals were of a substance that separated from solution with a net decrease in volume. These facts suggest that the development of cracks in portland cement after it has set may be due in some cases to the growth of crystals. Klein and Phillips, at the U. S. Bureau of Standards, have shown that the growth of calcium-hydroxide crystals in cement may continue for several weeks.

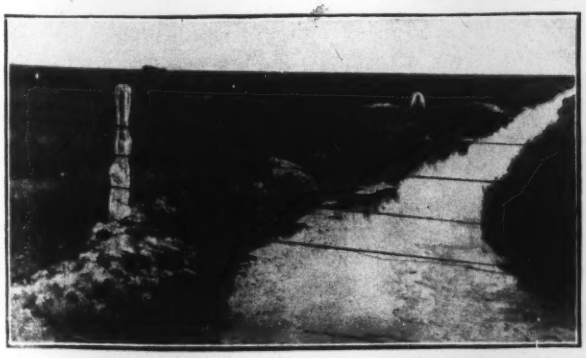
The fact that growing crystals can make room for themselves by exerting pressure on the surrounding material is of the utmost importance in geology; for it furnishes the most satisfactory explanation of many phenomena connected with the metamorphism of rocks, the disintegration of building stones, the growth of concretions and the formation of ore deposits.

Template Excavators Have Dug 100 Miles of Ditches

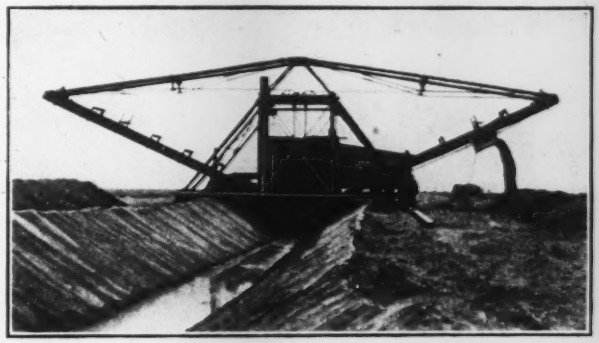
Irrigated Lands in San Luis Valley, Colorado, Waterlogged by Over-Irrigation and Flow from Artesian Wells

DRAINAGE ditching in the San Luis Valley, Colorado, is required to relieve the land of excess water due to careless irrigation and the flow from numerous artesian wells. The valley is a level tract, about 55 x 110 mi., without rivers or ravines to afford natural drainage for the water that comes to it from higher levels. Beneath the gravelly subsoil there is water under pressure. Nearly every ranch has a flowing well, and many of these are allowed to run continuously, causing an additional amount of surface water. Under these conditions, and with excessive irrigation, the land has become waterlogged, so that a comprehensive system of drainage is needed for virtually the entire area.

Extensive work of this kind is being done by the Charles & Gibson Co. of Alamosa, Colo., which owns large tracts of the land and develops them for settlement. One of the accompanying views shows a bank-full irrigation ditch with flowing wells helping to saturate the land. The other view shows one of the new drainage ditches for the reclamation of the land. The ditch system was laid out by Harry L. Morrison, civil engineer, Monte Vista, Colo. Over 100 miles of ditches have already been excavated.



THE SAN LUIS VALLEY IN COLORADO HAS BECOME WATERLOGGED BY FLOWING WELLS AND EXCESSIVE IRRIGATION



TEMPLATE EXCAVATOR CUTS DRAINAGE DITCHES IN THE SAN LUIS VALLEY, COLORADO

For this ditching work the Gibson Co. uses three Austin excavators of the template type, as shown. These machines give finished cuts with the desired section and side slopes. The work is mainly in a very loose and porous sandy soil, which is liable to cave or slide. It is found that banks cut to the finished slope in this way will stand much longer than where the ditches are excavated by other types of machines. The ditches are 8 ft. wide on the bottom, with slopes of 1 on 1½. They are mainly 6 to 8 ft. deep; but the machines can cut to a depth of 11 ft. The excavated material is deposited in spoil banks on both sides of the cut, leaving 8-ft. berms, so that in the future a machine can be run over the ditch for the purpose of cleaning and reshaping it.

On much of this job the machine works day and night (except Sundays), being equipped with an electric generating plant for lighting. There are five men in the day crew and four in the night crew (engineman, fireman, trackmen and water hauler). A team is used to shift the track stringers ahead, these being so placed that at the end of the day shift there is a sufficient length of track for the run of the night shift. The machine can excavate 800 to 1000 cu.yd. per 10-hour shift. It straddles the ditch as shown, and is carried by trucks riding on longitudinal stringers. Each stringer consists of a heavy timber bolted between a pair of steel channels.

The excavator carries a template made to the required cross-section of the ditch. Hinged to the ends of this are extension arms secured by ties from the upper part of the machine. The inclination of these arms can be adjusted as desired. Upon the template and its extensions travels a 1-yd. excavating bucket. This is hauled to and fro across the ditch, making a cut in each direction and dumping its contents on one or both sides of the ditch. The template is fed downward as the cut progresses, until the bottom is at the grade line. The template is then raised and the machine moves ahead a distance equal to the width of the bucket. The operation is then repeated.

Canada Prohibits Iron Exports

The Canadian government has decided to prohibit the exportation of iron and steel in unfinished or semifinished form suitable for use in manufactures, including pig iron, steel ingots, billets rods, shapes, angles and plates, except under license from the Department of Customs.

More Comment on the Behavior of Sea-Water Concrete

A Discussion of the Articles on Concrete in Sea Water by R. J. Wig and L. R. Ferguson Which Appeared in Recent Issues of "Engineering News-Record"

BEGINNING in *Engineering News-Record* of Sept. 20, 1917, and continuing thereafter until Oct. 25, there were five articles on the behavior of concrete in sea water by Rudolph J. Wig of the United States Bureau of Standards and Lewis R. Ferguson of the Portland Cement Association. The authors' conclusions were the result of a two-year inspection and study, under Government auspices, of the concrete structures in the oceans surrounding the United States, by far the most extended investigation of this use of concrete that has ever been made. The papers provoked some discussion, the publication of which has been held up for the authors' comment, which was delayed by their absence from home on a special Government detail. There are now printed herewith three discussions with the authors' closure.

Sea-Water Concrete Not Hopeless

BY J. L. WELLER
Consulting Engineer, St. Catharines, Ont.

It seems to the writer that the general impression apt to be taken from Messrs. Wig and Ferguson's articles on "Concrete in Sea Water" is too pessimistic. The large number of failures and partial failures examined by the authors shows "the common engineering practice to be incorrect" as they say, but I fail to see in the articles any real proof of "the need for radical modification in the design of reinforced-concrete structures" or that "reinforced concrete will, in practically any climate, begin in a short time to fail above sea water," or that "steel embedded to a depth of one or two inches is not properly protected against corrosion."

As a matter of fact the articles almost prove the exact opposite of such statements. For instance it is stated "A number of reinforced structures were found which were not cracked or deteriorated—one was ten years old." Also "one corner of a beam or pile may be cracked while the others show no sign of fracture," and "some structures show only slight signs of deterioration after six or seven years of exposure, while others are practically failures within four years."

It seems to me if even one steel rod embedded at a depth of less than "one or two inches" in any of the structures examined has remained intact for several years it is very clear proof that reinforced concrete can be made a decided success without any radical modification in the design. It is only necessary to ascertain the secret of how this one rod has been able to defy the penetrating activities of chlorine, and arrange matters in future in such a manner that all rods used will have the benefit of the same protection.

The authors in commenting on one corner of a beam or pile being cracked while the others show no sign of fracture say "This is due to the fact that some of the rods are embedded a little deeper, the concrete is somewhat denser or the exposure is not so severe." It would be interesting to know how this statement was verified or if it is merely a studied out conclusion. It seems to me quite certain that in many cases there must be another reason.

Regarding the effect of sea water on unreinforced concrete it apparently is little, if any, different from the effect of plain fresh water in this vicinity, as one could easily obtain here photographs of cases similar to those illustrated. We have, however, other examples of work which do not show the deterioration and consequently are satisfied that such deterioration is not a necessary part of concrete work.

The authors should let us know whether, in their inspection, they came across any abraded or broken concrete which had not been affected by sea water, and engineers along the coast should examine the concrete structures in their vicinity and let the profession know, through *Engineering News-Record*, if there are any authentic cases of abraded or broken surfaces which have not been injuriously affected, with as full particulars of the construction as it is possible to obtain. Engineers along the coast should also cut into and examine carefully any reinforced structure which has stood unimpaired for several years and endeavor to obtain the secret above mentioned.

It is hoped that judgment will be reserved until further information is available on this extremely important subject, as it will be very unfortunate if general advancement in the use of reinforced concrete should be retarded on circumstantial evidence which may, a little later, be found to have been misleading.

Old Treatises Emphasized Same Points

BY NATHAN C. JOHNSON
Consulting Engineer, New York City

With great interest the writer has followed the series of articles on "Concrete in Sea Water" by Messrs. Wig and Ferguson. The subject is of such present importance and of so much greater consequence in the immediate future that solving the riddle of permanence is an achievement to hope for.

In the light of these most modern studies it is interesting to note their agreement with or divergence from like studies of 70 years ago. On the writer's bookshelves and doubtless in many other private libraries as well there has been a copy of Gillmore's classic, studied so long ago as to be forgotten. Urged by some faint memory, it has now been read again; and the following extracts taken from it will, it is believed, prove of interest. All italics are the writer's own.

The similarity between destruction of concretes in sea water and in fresh water is noted by Gillmore in the following quotation from the "Memoir" of Chatoney and Rivot, published in 1855:

> The authors have had in view, in their memoir, only those mortars exposed to the action of sea water, but they entertain the opinion that most of these observations are applicable to mortars immersed in fresh water.

The relation of porosity to such disintegrations is then commented on by Gillmore as follows:

When a solid body, of any degree of porosity, is immersed in water or any other fluid, it rapidly absorbs a certain quantity of the latter, until the point of complete saturation is reached; *and if, in addition, the fluid possesses reacting powers*, certain chemical changes will ensue within the pores of the solid body.

No less at the present time recognition of the importance of porosity in its relation to disintegration becomes necessary when the process of sulphating, even over lengthened time, is considered chemically. Average analyses of 150 samples by Forchammer and of 77 samples by Dittmar show the following composition of sea water:

Salts		Per 1000 Parts Water
Sodium Chloride	—NaCl	27 213
Magnesium Chloride	—$MgCl_2$	3 807
Magnesium Sulphate	—$MgSO_4$	1 658
Calcium Sulphate	—$CaSO_4$	1 260
Potassium Sulphate	—K_2SO_4	0 863
Calcium Carbonate	—$CaCO_3$	0 123
Magnesium Bromide	—$MgBr_2$	0 076
		35 000

From this tabulation it is seen that for each liter of sea water there are present as a maximum 2.521 grams of sulphate salts having bases replacable by the calcium from concrete, always *provided that contact of such calcium with this dilute sulphate solution is assured.*

Solving an equation for replacement as sulphate of even so much as 50 per cent. of the lime content of the 500-odd pounds of cement in a cubic yard of 1:2:4 concrete, progressive admission into the concrete of sea water in great quantities becomes a necessary corollary of any explanation of disintegration by sulphating; and this argues a degree of porosity for the concrete which, by admission of water alone, would of itself account for much of the trouble by removal of the always soluble lime hydrate, whether or not "the fluid possesses reacting powers."

And in the same connection, Gilmore quotes from M. Noel (Annales des Ponts et Chaussées, 1853) with regard to the superior endurance of a dock at Genoa, Italy, as follows:

> If the work is examined more in detail, it is found that the concrete which constitutes the bottom of the apron and the exterior surface of the side walls has acquired a very great hardness in consequence of its composition (puzzolana of Rome, ordinary lime and calcareous gravel) *and that it is free from all porosity*, in consequence of the care which the skillful director of these works took to clear his beton *by constantly pumping up the washings (laitance) during the operation.*

In the latter part of this quotation the writer recognizes anticipating of his own suggestion (*Engineering Record*, Dec. 30, 1916) for removing laitance during the placing of concrete. He now regrets, the better to have met certain critics, that he did not then know the long standing prestige of this procedure.

Concerning the destruction of water-immersed concretes, Gillmore quotes further from the "Memoir" of Chatoney and Rivot (1855):

> Artificial . . . puzzolanas have not yet been successful in the ocean and their employment will always be attended with difficulty *principally on account of the irregularity of the mortars into which they are introduced.*

And from his own experience:

> The disintegration of mortars coincides with the increase in the quantity of the sulphate of lime and must be attributed to that salt, produced by the action upon the lime, of the sulphate of magnesia of the sea water. It was produced *in variable proportions in all the gangs experimented upon* but destroys them *only in the cases when it is produced in sufficient quantities.*

In other words, *what quality* of substance that has been denominated concrete composes a structure? Lack of uniformity is no less true today than in 1850 or earlier.

Quality, measured not only by the composition of a cement but more by *freedom from porosity and water penetration*, is often emphasized by Gillmore. The prevalence of porosity whereby "Alterations are gradually produced by the dissolving action of the gas and the salts which the water contains, *modified by the temperature and the action of tides*" are, he notes, somewhat retarded, "by the exudations of small marine animals, such as barnacles, forming a protecting coating about the concrete," and this retardation he seeks to secure by natural stone facings and wooden casings about the concrete at flow levels.

Disintegration in sea water concretes, he notes

> was not observed until after the time when a too absolute confidence in hydraulic materials led to the execution of concrete masonry in immediate contact with water, *without any revertment of cut stone or carpentry and without any of the protections which the ancient (Roman) works received.*

Summing up his own and the conclusions of his predecessors, Gillmore says:

> From the foregoing it would appear that sea water will destroy the gangs of all mortars derived from the sources indicated, *if it be allowed to penertate the immersed masses;* but as some mortars do practically withstand continuous immersion in sea water, it follows that the latter meets on the surface something to *impede or prevent its penetrations.* These impediments are:
>
> 1st and principally, a coating of carbonate of lime; the carbonic acid being supplied from the atmosphere before immersion and subsequently from the water;
>
> 2nd in certain cases, particularly with gangs derived from magnesian limestones, the formation of carbonate of magnesia.
>
> 3rd an incrustation of shells and submarine vegetation.

Gillmore, of course, dealt with hydraulic limes and natural cements, with little or none of the modern portlands. Basically, however, his words read on conditions as we find them in concretes today; and his emphasis on non-porous concretes and the variability of result commonly produced is food for thought and reflection.

And in no disparaging sense as regards this excellent series, I quote an old fireplace legend:

"And out of olde bookes, in goode faithe, cometh all this new knowledge that men learne."

Porosity the Vital Point to Consider

By A. H. Rhett
Toch Brothers, New York City

In the articles by Messrs. Wig and Ferguson on the disintegration of concrete subject to the action of sea water the explanation advanced as to the protective value of the lime carbonate skin is particularly interesting.

The last paragraph of the article in the Oct. 4 issue states, however, "to sum up the subject in a few words, *well made* concrete properly placed, if not subject to mechanical abrasion, is permanent in sea water." This immediately suggests questions. Suppose the concrete is not "well made" and not "properly mixed." Is not the deterioration worse in a concrete that is not "well made" and "properly placed" and if so why not? Is there not also a lime carbonate skin on concrete not "well made" and not "well placed"?

The report on "Tests of Concrete Specimens in Sea Water at Boston Navy Yard" presented by R. E. Bakenhus at the meeting of the American Society of Civil Engineers on Jan. 3, 1917, at New York, shows, as far as these tests were concerned:

(1) That rich mixes were superior to lean. (2) That wet mixes were superior to dry. (3) That extra care in mixing produced decidedly beneficial results. (4) That hydrated lime was of no benefit, but rather a detriment. (5) That the addition of Sylvester wash was harmful. (6) That the addition of clay to the cement had a slightly beneficial result.

Are we to interpret these results to mean, in accordance with this article, that when the concrete is rich, when it is wet, when it is thoroughly mixed, when it has clay added to it, it has a heavy skin; while when it is dry, when it has lime added to it, when it is treated with the Sylvester wash it has no skin, or are we to assume that the rich, wet clayey mixes were not subject to mechanical erosion, while the lean, dry and lime mixes were, though they occupied adjacent positions in close proximity?

While there can be no doubt from the facts advanced that this skin performs an important function in the preservation of the concrete, it can be legitimately questioned from the facts at hand that it is the ultimate and total factor to be considered, as might be inferred from the article.

Technologic paper No. 12 of the Bureau of Standards on the "Action of Alkali and Sea Water on Cements" states that "hydraulic cement is readily decomposed if intimately exposed to the chemical action of various sulphate and chloride solutions" and that the lime in the cement is the element attacked as stated in the present paper. It also states that "portland cement mortar or concrete, if porous, can be disintegrated by the mechanical forces exerted by the crystallization of almost any salt in its pores if *sufficient amount* is permitted to accumulate and a rapid formation of crystals is brought about by drying."

It is universally agreed that disintegration occurs principally between the high and low water marks and if the face of a concrete so exposed is porous the above stated requirements for disintegration would be likely to subsist.

Recession of the tide would bring about the evaporation of the water caught in the pores during the high tide period and cause the deposit of sulphate and chloride salts and this action being indefinitely repeated, would eventually result in a saturated solution being retained in the pores. This would not only result in more intense chemical action but would fulfill the condition quoted above that "portland cement mortar or concrete *if porous* can be disintegrated, etc."

In fact it might even be inferred that sea water in its normal condition is not sufficienly strong to start the chemical reaction and the concentration due to the alternate deposit, and evaporation in the pores is necessary to bring it about. That porosity is a very important if not the prime factor would certainly seem to be confirmed by the Boston Navy Yard tests and in regard to these Messrs. Wig and Ferguson have themselves stated that six of the twenty-four showed practically no deterioration, those being of a wet 1:1:2 mix, and consequently more or less non-porous, while those that did show the worst disintegration were the lean dry and of necessity porous mixes. It is impossible to think that those that showed no deterioration were not subject to the same mechanical erosion as their defective neighbors.

It seems possible also that the roughening of the surface from mechanical erosion and the consequent opportunity presented for deposit and concentration is more responsible for disintegration than the removal of the carbonated skin and the fact that there is no renewal of this skin would substantiate this view. It is also noted that disintegration is particularly conspicuous along the seams, and while the explanation offered as to the increased erosion along these lines due to softness is rational, it cannot be ignored that these lines are lines of porosity also.

It is to be noted, too, that in "properly placed" concrete the tamping tends to drive the mortar against the form boards and this mortar is richer and consequently probably more non-porous than the general mass behind it.

What has been said above applies particularly to the article appearing in *Engineering News-Record* of Oct. 4, p. 641, and its unqualified text, that "chemical disintegration cannot take place unless the *original surface* of the concrete as molded is *first abraded or eroded by mechanical means.*"

When however, we turn to the article in the Oct. 25 issue we find a somewhat different theme. The article opens with "The character of the workmanship has an important bearing on the ability of concrete to resist the action of sea water. Only contractors of experience employing competent men should be intrusted, etc." We are tempted to ask what is the connecting link between the lime carbonate skin and "character of workmanship," "contractors of experience" and "competent men."

We next find instanced "a very large project which included several thousand pier structures," and find that when the work "was done in accordance with usual methods, more than 50% of the footings were found to be seriously defective," while when a "marked improvement in the character of the workmanship was insisted upon," "the result was that only about 1% of these piers had any defects." When "even more attention to details" was insisted upon, "the last several hundred piers have shown practically no defects whatever."

In other words, with a given mix and similar conditions of erosion we find the durability proportional to the workmanship. Referring back to the article of Oct. 4 we find the statement that "When green concrete is placed in the forms, the lime of the cement *at* or *near* the *surface* is in a form to combine readily with carbon dioxide in the atmosphere" or "water." In view of this statement we are led to ask the question: With a given amount of cement present in each case to be chemically acted upon at the surface by the sea water, what is the connecting link between this chemical reaction to form a lime carbonate skin and the character of the workmanship?

Further on we find, "Smoothness of the exposed face of the concrete assists materially in resisting sea water attack." Why? Is the chemical reaction to form the

lime carbonate skin stronger on a smooth surface than a rough one?

Still further we find much emphasis laid on the amount of water used in mixing, "it is of even greater importance, perhaps, than the proportioning of the concrete," and examples are cited to show that "a medium consistency has successfully resisted disintegration under very severe exposure." Are we to infer, then, that in a concrete with a given proportion of cement the formation of the lime carbonate skin is a function of the amount of mixing water used? We had been previously told that it is due to combination of the lime of the cement *near the surface* with carbon dioxide in the atmosphere or sea water.

It is difficult to see where the authors have substantiated the two main premises of the Oct. 4 article that the lime carbonate skin, if formed, has the great value claimed, and that "disintegration cannot take place unless the original surface of the concrete is first abraded or eroded from mechanical means." We do, however, find very strong evidence in all the examples cited that a well graded, carefully mixed, carefully placed, in other words, a non-porous concrete, gave permanence.

The Authors' Reply to the Criticisms

By R. J. Wig and L. R. Ferguson

The authors are in substantial accord with Mr. Weller in that it is their strong conviction that both mass and reinforced concrete can be used in sea water with durable results. Mass concrete has been used for years. Reinforced concrete, however, has not and is not now generally being designed so as to insure durable structures where exposed to sea water or sea air.

Mr. Weller has apparently lost sight of the fact that all reinforced-concrete structures in sea water are comparatively young and the deterioration due to corrosion and spalling is progressive, being first evidenced in the localities where the exposure is most severe or the steel is least protected. Therefore Mr. Weller's conclusion that "if even one steel rod embedded at a depth of less than one or two inches in any of the structures examined has remained intact for several years it is very clear proof that reinforced concrete can be made a decided success without any radical modification in the design," is without warrant unless Mr. Weller is satisfied with a life of "several years," which of course he is not.

In every instance where a beam or pile was cut into, one corner being cracked and the adjoining corner not cracked, the steel was either more deeply imbedded or the concrete appeared to be more dense in the latter case than in the former.

The conditions at New York City are not comparable with those at Long Beach, Long Island, nor are conditions at Norfolk, Va., comparable with those at Key West, Florida.

There is nothing mysterious about these conditions, nor is there any question of their existence, for they were in each case personally examined by the authors.

The authors hope engineers will follow Mr. Weller's suggestion and investigate the conditions of the structures in their locality, for it is the authors' firm conviction that if present methods and designs are not changed comparatively rapid deterioration of the exposed portions of reinforced-concrete structures is inevitable. As a matter of interest several reports have been received since the publication of these articles from various localities all of which confirm the statements made. The authors recognize that all mass concrete in sea water in northern latitudes is subject to the same disintegrating agents as in fresh water. In addition to this, however, there is chemical disintegration which is plainly visible upon close examination and is distinctly peculiar to sea water exposure. That such action is occurring is further proved beyond a doubt by chemical analysis.

Replying to Mr. Johnson's comments the authors have not claimed originality for most of their statements, rather they are confirmatory of conclusions reached by others many years ago. The comprehensive character of the investigation, however, makes possible more emphatic statements than might otherwise be the case and the knowledge gained relating to the general deterioration of reinforced concrete is believed to be new.

Referring to Mr. Rhett's comments the authors are in complete agreement with the conclusions reached by R. E. Bakenhus in his report on "Tests of Concrete Specimens in Sea Water at Boston Navy Yard," and so state in their discussion of his paper.

In northern latitudes where structures are subjected to mechanical erosion from ice as well as the incessant wash of the sea, only dense rich mixtures are capable of retaining the carbonated surface. In southern latitudes, where there is no freezing and mechanical erosion is not so severe, weak and porous structures may sometimes be found without appreciable deterioration.

As stated in the articles, even though chemical disintegration occurs in structures located in southern latitudes it may progress very slowly if the exposure conditions are such as not to permit of severe erosion.

There is practically no crystallization of sea salts from evaporation between the elevation of high and low water. This all occurs above high water, which statement can be readily verified by the chemical analysis of sections taken from the structure at these points.

The behavior of each structure is dependent upon not only its own physical condition but also the conditions to which it is exposed.

Urge Laboratories for Every Water-Works

The California State Board of Health is encouraging the installation of laboratories at water-works throughout the state, so that more frequent analysis may be made for the guidance of the men in charge of the purifying devices. Monthly analyses now made by the board are considered entirely insufficient, especially where the water is treated. Men in charge of the few laboratories that have been installed as a result of this movement have been visiting the laboratory of the Bureau of Sanitary Engineering maintained at Berkeley under the direction of C. G. Gillespie, chief engineer. There they receive instruction in the procedure and interpretation of analysis. Not only have chemists received instruction, but also a number of men without scientific training.

Water-Waste Report Written To Educate Lay Public

Revenues Depleted, Filters Needed, Waste Prevention Imperative in Chicago—Meters Will Solve Problem, Says Bureau of Public Efficiency

WATER waste and its prevention are the most important problems discussed in a recent report on "The Water-Works System of the City of Chicago" by the Chicago Bureau of Public Efficiency. Finance and filtration are the two other topics which are discussed in detail. The report is based on a preliminary survey of the whole situation made in 1915 by John W. Alvord, consulting engineer. John Ericson, city engineer and W. J. McCourt, superintendent of water, coöperated fully in the investigation. Mr. Alvord's tables and data on waste were brought down to date by the bureau and he concurred in the conclusions reached.

Lay citizens are those for whom the report is written especially, in order to inform and educate them as to the gravity of the situation. The bureau, one of whose trustees is Onward Bates, past president American Society of Civil Engineers, holds that no extended discussion is needed so far as engineers and water-works officials are concerned. For this reason the method of presentation of the problem and its remedy is of more than usual interest. The following is an abstract of the conclusions of the report.

Chicago pumps from Lake Michigan an average of 259 gal. daily per capita for 2,500,000 people. This is more water than is furnished by any other water-works system in the world.

Financial Problem Serious

At the close of 1916 the original cost of the water-works plant was approximately $70,000,000. This cost has been increasing rapidly during recent years, having practically doubled since 1901. Notwithstanding the fact that the pumping equipment, tunnels and distribution mains are now far overbuilt for the reasonable requirements of the city, enlargements and extensions are progressing at a cost of about $3,500,000 a year. These extensions result from the policy of trying to cope with the problem of water waste by constantly providing additional pumps and other equipment.

The revenue of the water-works is now about $7,000,000 annually and is increasing at the rate of from $300,000 to $400,000 a year. In 1916, after deducting operating and maintenance costs, including depreciation, the water-works business paid about 3.6% on the capital outlay.

The excess of revenue over operating and maintenance costs, which represents the return on the public's invested capital, in recent years has amounted to from $2,500,000 to $3,000,000 annually. However, instead of the public profiting by this return through lower water rates, the money is being continually reinvested in extensions of the plant, which are necessitated by the excessive amount of water waste and leakage which prevail. Thus waste and leakage are depriving the community of a substantial part of the benefit which it should obtain through its ownership of the water-works.

Lake Michigan furnishes an unlimited quantity of water of a high degree of original purity. The trouble which Chicago has always had with its water-supply has been due to the large amount of polluting matter which the city itself and neighboring cities and towns have discharged into the lake.

Efforts to avoid and counteract this pollution by locating the intake cribs as far from the shore as practicable, by keeping sewage and other contaminating matter out of the lake, and more recently by sterilizing the water with chlorine gas, have greatly improved the quality of the supply.

Under present conditions the lake water at Chicago is exceptionally good a large part of the time without chemical or other treatment. At other times it is badly polluted and unfit for drinking unless disinfected. There are several well-defined sources of this pollution. None of them is continuous and uniform. All are occasional only and depend largely upon weather conditions and accidents of navigation. But that does not lessen the danger from pollution. In some ways it tends to increase the peril, since it may produce a false sense of security.

Disinfection will not remove the muddy or turbid condition of the water which is frequently caused by the stirring up of the bottom of the lake by storms, and which always makes the water uninviting—not only for drinking but also for bathing and other domestic purposes. To obtain water free from turbidity it will be necessary either to filter the present supply or to extend the intake tunnels out into the lake to points 12 to 15 miles offshore. In view of the uncertainty of obtaining water which is free from occasional pollution, even at these more distant points, and of the almost prohibitive cost of such tunnel extensions, it is considered impracticable to build them.

Public health authorities and the public generally are constantly demanding a higher standard of purity for domestic water-supplies, and it is not to be expected that the people of the city will long be content with a supply which is inferior to that of other great cities of the world. It seems safe to predict, therefore, that in the not-far-distant future Chicago will demand water of greater purity and cleanliness, and that filtration, which will eliminate both the danger of bacterial impurities and turbidity, will be the means of obtaining such a supply.

Waste Prevention the Big Problem

Notwithstanding the unlimited quantity of water close at hand and unusually favorable conditions for its distribution, there are constantly recurring complaints of a shortage of water and of insufficient pressure in various sections of the city.

The pressures which prevail are generally too low for efficient service. In most parts of the city water is not being supplied above the third floors at any time.

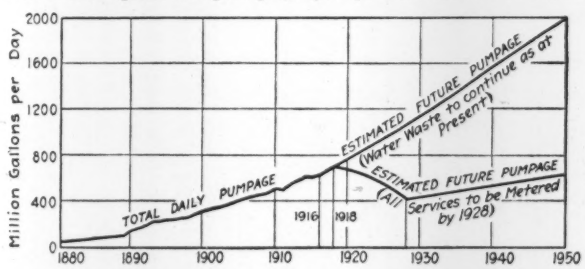
During periods when the demand for water is greatest there is a failure to supply third floors. In some sections of the city the service is not satisfactory and uninterrupted even on lower floors. Consumers who do not live near pumping stations or adjacent to large supply mains are frequently without water.

The inadequacy of the Chicago water supply is not due to any lack of pumping equipment, but is due entirely to the vast amount of water lost through waste and leakage. Waste and leakage are also causing enormous financial losses and have an important bearing upon the ultimate problems of filtration and of sewage disposal.

Only one important city in the country—Buffalo—supplies more water per person than does Chicago. Cleveland and Milwaukee, both lake cities and important industrial centers in which natural conditions of consumption are similar to those in Chicago, report a pumpage per person of 113 and 118 gal. per day respectively.

In a general way it is known that only about 40% of the water pumped in Chicago is used in the sense that it is consumed for some purpose for which water is necessary or has a real value, and that the remaining 60% is lost in one way or another through waste and leakage. Part of this loss occurs in the course of the delivery of the water from the pumping stations to the premises of the consumers and results from leaks in pumps, distribution mains and service pipes; part of it occurs after the water is delivered to the consumers' premises and is occasioned by leaky pipes and plumbing fixtures and by wilful waste.

It is believed that if effective waste control measures are adopted the pumpage per person can be reduced



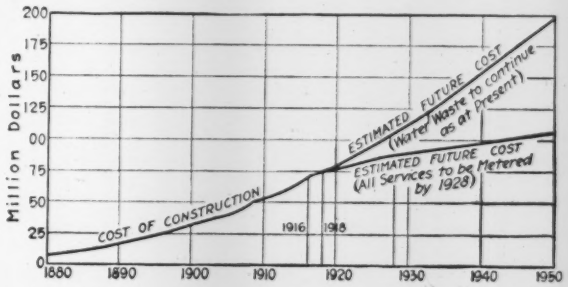
WITH METERS CHICAGO WILL NEED NO NEW PUMPS FOR THE NEXT 33 YEARS

to 125 gal. per day. By reducing its pumpage to this figure, Chicago will effect a daily saving of 330,000,000 gal. of water. The saving which can be thus effected more than equals the combined supply of Milwaukee, Boston, Cleveland and St. Louis.

Besides its ruinous effect upon service, the transportation of the large volume of water lost through waste and leakage means a serious financial loss. There is an abundance of water in the lake, and, of course, the water itself is free, but the city is in the business of transporting it from the lake to the premises of consumers and its transportation costs money. During 1916 it costs more than $1,000,000 just to pump water which is often regarded as free.

It is now costing about $500,000 a year to pump water which is later wasted or which leaks away. In 1916, 190,000 tons of coal, valued at $450,000, were consumed in the Chicago pumping stations. Half of this amount was used to pump water that was wasted. In view of the problems now involved in mining and transporting coal and of the resulting need for conserving its use, the necessity for preventing water waste, and hence fuel waste, is becoming more and more urgent.

There are two methods of controlling waste on consumers' premises: One is by frequent house-to-house inspections; the other is by the installation of meters. House-to-house inspections are never completely effec-



IN 33 YEARS UNIVERSAL METERING WILL SAVE THE CITY $135,000,000

tive. They are expensive and uneconomical. They produce only temporary results. They are generally burdensome and annoying to householders and to be even measurably effective must be accompanied by the rigid enforcement of penalties.

Metering, on the other hand, is effective and the results obtained by it are permanent. Considering that its cost is about the same as the cost for house-to-house inspections, it is therefore by far the more economical method. It is also the equitable way to apportion water charges, since each consumer pays for the water that he takes and no more.

Notwithstanding its obvious advantages, there is generally a strong prejudice against metering wherever it has not been adopted. It is significant, however, that cities in which meters have been installed have not gone back to former methods, the meters having proved satisfactory both to the municipality and to the consumers.

Experience has demonstrated that where meters have been introduced they neither restrict the use of water nor increase water bills. It is neither necessary nor desirable to restrict the use of water. It should be supplied in abundance and its use encouraged. With practically every consumer exercising care to eliminate waste, water can be furnished so cheaply that no one need think of restricting the amount of which he can make any use. Metering is advocated for Chicago partly because it is the most effective means of insuring an abundant supply under sufficient pressure to enable all consumers to obtain promptly and at all times the water which they require and are entitled to for their legitimate uses. Such a condition has never existed in Chicago.

The bureau recommends that the city authorities at once establish universal metering as a policy and that they take the necessary steps to put it completely into effect during the next ten years. It is important to adopt a policy of universal metering and to preserve its continuity, because until such a policy is definitely established water-works officials will be obliged to con

tinue constructing additions to the plant to meet waste conditions which will have to be faced in the future.

The meters should be owned by the city and should be installed and maintained free of expense to consumers. The bureau believes that in putting universal metering into effect the meter rate of 6⅓c. per thousand gallons, which is now charged, should be retained for the present, and that reasonable minimum rates should be established. This will result advantageously to thousands of small property owners and will not materially impair the water revenue.

Metering a Profitable Business

If waste and leakage are brought under effective control during the next ten years, the pumpage of the Chicago water-works can be reduced to 425,000,000 gal. per day by 1928, as compared with 645,000,000 gal. per day in 1916; and further, the daily pumpage can be kept considerably below the 1916 figure as late as 1950.

This reduction in pumpage will make possible an immense saving in expenditures for water-works plant. It will mean that additional tunnels, cribs and pumping stations will not be needed for 33 years. The reduced pumpage will also effect very large savings in operating and maintenance costs.

The bureau estimates that the saving in interest and depreciation charges which can be effected during the next 33 years by reducing the necessity for capital outlays for new pumping stations, cribs, tunnels and other equipment, will aggregate $66,000,000 and that the further saving which can be effected in operating costs during that time will be $69,000,000. Thus the total saving which will result from universal metering will aggregate $135,000,000 between now and 1950. The savings estimated are net, deductions having been made both for the cost of installing and for reading and maintaining the meters.

The cost of installing meters will aggregate approximately $9,000,000 during the first ten years and $200,000 per year thereafter. The annual cost of reading and repairing meters will average approximately $290,000 per year for the first ten years and $575,000 per year thereafter.

The city engineer and other administrative officials for more than 15 years have been urging the city council to authorize metering as the only means by which permanent relief from waste and leakage, and the resultant inefficient service and financial loss, can be obtained. The mayor and the aldermen, however, have thus far failed to support these appeals in anything like an adequate way. The public also is quite generally either apathetic or antagonistic to the idea of metering. This is because the public, for the most part, is not acquainted with the facts concerning the effect of meters upon the use of water and upon water bills.

Finally, the bureau states that the city council should recognize this state of affairs and accept the responsibility for remedying the existing situation by initiating and carrying out a program for universal metering. In this undertaking the council should have the earnest and active support of every householder, tenant and property owner in the city.

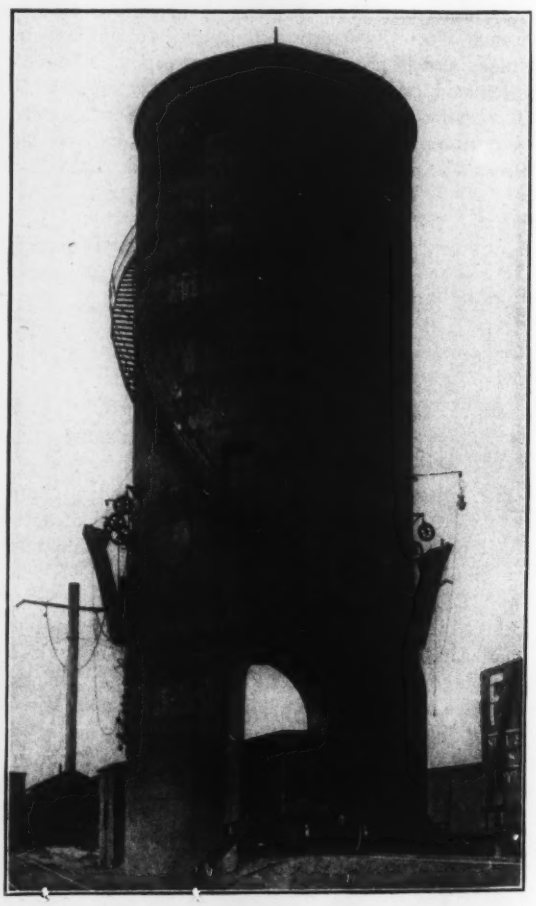
Frisco Railway Tries Cylindrical Coaling Stations

In First Two Examples of New Design for Concrete Plants of Medium Capacity Coal Cars Pass Through Base of Tower

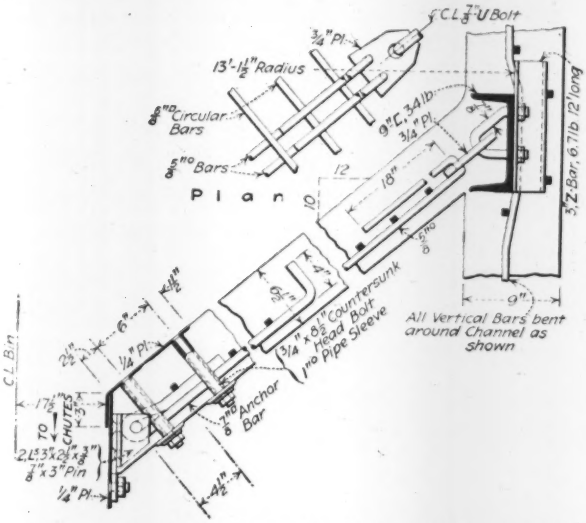
CIRCULAR reinforced-concrete bins for railway coaling stations, with the cylindrical wall forming the bin and its supporting tower, represent a new type of construction employed recently for stations requiring from 250 to 300 tons storage capacity. The type is limited practically to the smaller class of coaling stations, since track spacing will usually limit the diameter, and if the bin is made deep in proportion to its diameter the coal is likely to arch or choke instead of flowing freely.

Advantages claimed for the circular design are economy of material, and low cost due to the use of special circular forms. This applies to the plain cylindrical shape. Where the design is complicated by interior elevator legs and a sand pocket, as in the stations mentioned, the cost is increased considerably, and may be about the same as for a rectangular design.

Two of these circular-bin concrete coaling stations have been built for the St. Louis & San Francisco Ry. They have an outside diameter of 27 ft. and are identi-



THIS TYPE OF COALING STATION ESPECIALLY ADAPTED TO SMALL CAPACITIES



ANCHORS AND REINFORCEMENT IN CONICAL BOTTOM OF BIN OF CYLINDRICAL COALING STATION

cal in design, except as to depth and capacity of bin. The one at West Tulsa, Okla., has a 300-ton bin 29½ ft. deep, exclusive of the 9½-ft. hopper bottom, and has a total height of 75 ft. The one at Willow Springs, Mo., has a 250-ton bin 25 ft. deep, or 34½ ft. including the hopper bottom, and the total height of tower and bin is 70 ft. Each station serves two engine tracks, spaced 21 and 23 ft. from the center of the tower.

Coal cars are run on a track passing through the tower, which has openings 16 ft. wide and 21 ft. high, strengthened by portal arches, as shown. Coal is dumped into a track hopper having an inclined steel flight conveyor feeding a bucket-elevating-conveyor which discharges at the top of the bin. The hopper-shaped bottom of the bin feeds the coaling chutes on either side. Within the bin are two legs for the elevator and a semi-cylindrical pocket for dry sand, which is piped to the sandboxes of engines taking coal. This pocket is of 10 and 5 cu.yd. capacity in the larger and smaller bins, respectively.

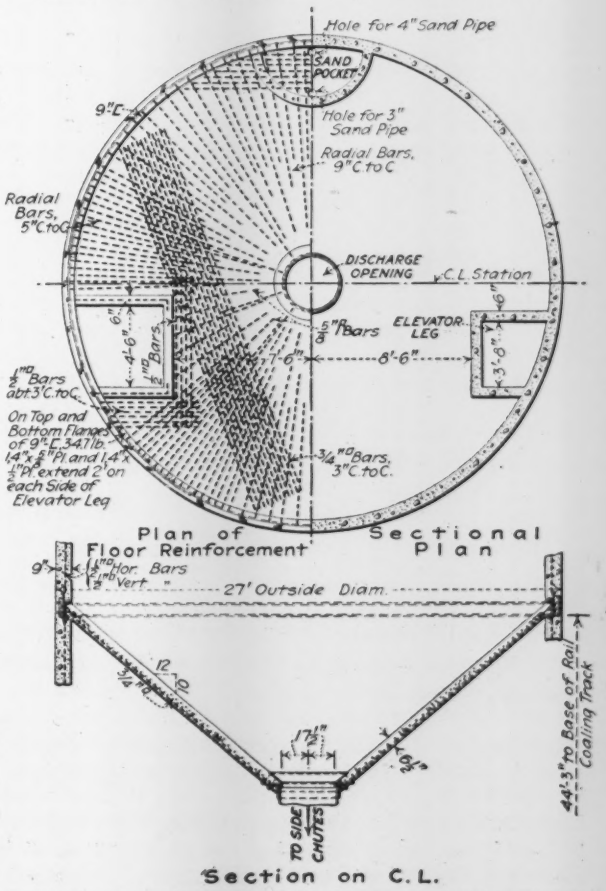
Access to an inspection door at the top is given by an exterior steel spiral stairway. Below the bin this is inside the tower, and it is reached from the platform at the side of the receiving track. Each station has a steam engine for operating the two conveyors. The larger plant has a 25-hp. engine and can handle 80 tons per hour. The smaller plant has a 20-hp. engine and can handle 60 tons per hour.

The concrete was a 1:2:4 mix, made with broken stone. To make the receiving pit waterproof, hydrated lime was added in the proportion of about 60 lb. per cu.yd. of concrete. The circular wall is 9 in. thick for the entire height, but from the foundation to the top of the portal arches four columns are formed on the interior of this wall. Up to this same level the steel reinforcement consists of two rings of vertical bars, with inner and outer hoops. Above this there is a single row of vertical bars and hoops. A 3-in. conical slab forms the roof, and 6-in. walls are used for the elevator legs and sand pocket inside the coal bin.

Special attachments are employed for the reinforcing bars in the conical hopper forming the bottom of the bin. In the circular wall at the top of the hopper is a ring consisting of a 9-in. channel having U-bolt anchors attached to its web. Each anchor carries a plate having holes for the hooked ends of the radial hopper bars. The center is a 36-in. riveted steel drop pipe, through which the coal passes. The drop pipe is anchored to the concrete by bars having their lower ends looped over pins in brackets riveted to the drop pipe. The upper ends of the bars are turned up 4 in. and embedded in the concrete floor of the hopper. The reinforcing is of deformed bars of medium openhearth steel having an ultimate strength of 60,000 lb. with an elastic limit not less than 50% the ultimate strength.

Wood forms were made by the builders in 4-ft. sections. As the concrete was poured the sections were raised by Stewart jacks operating on vertical lengths of wrought-iron pipe set in the wall. Concrete was made in a Smith mixer of 14 cu.ft. capacity and was conveyed to the forms by means of an elevator tower and steel chutes. Concreting was continuous.

Adoption of this type was based on the fact that the bids were lower than those for any other type. Higher bids were submitted later for similar plants, however. The two coaling stations were designed and built by Fairbanks, Morse & Co., Chicago, under the direction of F. G. Jonah, chief engineer of the St. Louis & San Francisco Railway.


Hole for 4" Sand Pipe
SAND POCKET
9" C.
Hole for 3" Sand Pipe
Radial Bars, 9" C to C
Radial Bars, 5" C to C
DISCHARGE OPENING
C.L. Station
ELEVATOR LEG
6" Bars
1" ø Bars abt 3" C. to C.
On Top and Bottom Flanges of 9" C. 34.7 lb. 14" x ⅝" Pl. and 1.4" x 1" Pl. extend 2" on each Side of Elevator Leg
¾" ø Bars, 3" C. to C.
Plan of Floor Reinforcement
Sectional Plan
½" ø Hor. Bars
½" ø Vert. "
27' Outside Diam.
12-12
TO SIDE CHUTES
44'-3" to Base of Rail Coaling Track
Section on C.L.

DETAILS OF CYLINDRICAL CONCRETE COALING STATION

Cost of Maintenance and Repair of Connecticut Roads

Figures Covering Trunk Line Highways Reflect the Increased Prices of Labor and Materials During the Past Year

BOTH the increase in motor traffic and the higher cost of work, labor and material during the past year have been abnormal and have caused the expenditure of large sums for the ordinary repairs of Connecticut roads and increased the outlay for permanent repairs, according to the annual report of Charles J. Bennett, Connecticut highway commissioner, covering the term ending Sept. 30, 1917.

The total amount expended for both ordinary and permanent repairs of trunk line roads for the mileage and repair for the past four years is as follows:

1913–14	$785,099	1915–16	$981,609
1914–15	879,936	1916–17	1,495,486

These amounts include all expenditures for maintenance, ordinary and permanent work, plus the cost of oiling the state-aid roads, which is paid by the state out of the motor-vehicle tax receipts.

The following table gives the cost of ordinary maintenance and the cost of permanent repairs, such as the placing of permanent pavement on trunk line roads previously constructed:

	Total	Ordinary	Miles Maintained	Permanent
1913–14	$785,099	$587,183	744 57	$197,917
1914–15	879,936	665,762	906 92	214,175
1915–16	981,609	567,130	915 76	414,479
1916–17	1,495,486	709,420	923 43	786,067

The figures above quoted do not take into account the cost of supervision and equipment, but cover only the net cost to the state. The funds for this purpose were appropriated by the legislature of 1915 and amounted to $1,000,000 for two years, to which would be added the receipts from automobile licenses for the fiscal year Oct. 1, 1916, to Oct. 1, 1917, plus small amounts of money available and unexpended from previous appropriation.

The expenditure for permanent improvements, which is listed in the last column, consisted in placing hard pavements on roads already constructed, and shows a remarkable increase during four years—the last year being more than twice that of any two preceding years. The above figures cover only the expenditures on trunk line highways, for which the state pays the entire cost of repairs. To this must be added the cost of oiling state-aid roads. Ordinary repairs of state-aid roads are made by the state department in coöperation with the towns—the state paying three-quarters of the cost and the town the balance.

Cost of Sewage Screens for Milwaukee

Engineering News-Record has been requested by T. Chalkley Hatton, chief engineer of the Milwaukee Sewerage Commission, to state that the third paragraph from the end of his letter appearing in these columns Dec. 6, 1917, p. 1073, should have read as follows: "From the table appearing in appendix to this report the estimated cost of the fine screening plant is $227,615, and the cost of operating the same, exclusive of overheads, is $0.46 per million gallons, or approximately $14,000." In the letter as published the unit cost is given as $0.23 and the total operating cost as $7000.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Employees with Better Jobs in Sight

Sir—Referring to "Professional Questions" and request on p. 824 of your Nov. 1 issue for discussion of the practice of some employers "(1) declining to consent to their employees being offered more remunerative positions by others, when their consent is asked in advance; or (2) declining to recommend employees who have been approached by prospective employers who offer greater remuneration," I believe it ought not to be necessary to have to discuss a question of this kind. However, we do know that there are people so selfish that it makes them dishonest, and they would deny advancement to their best employees whom they feel they cannot keep, or afford to keep, in face of competition for good men by concerns that can pay such men what they are worth and, at the same time, take them into their organizations.

There is only one rule to follow when it develops that we have employees or men in our employ or in our organization who are worthy of positions much better than those we can offer them, and that is to help them better themselves by recommending them as the opportunities present themselves.

If an employer tries to keep worthy employees by failing to recommend them or help them to advance, he is really an enemy to his country. How are we to advance if we throttle ambitious men by failing to advance them or recommend them, just because we want to keep them in our own organization for what we can make out of them? In the mind of the writer, this is the worst kind of slavery. By doing the opposite we "cast our bread upon the waters."

The best men of an organization ought to be worth as much to it as to other concerns. Why let the good men get away? Recognize their worth first.

C. W. KOINER,
General Manager, Municipal Lighting Department.
Pasadena, Calif.

What Is a "Consulting Engineer?"

Sir—Regarding the use of the word "consulting" as applied to engineers in private practice, especially as commented upon by Mr. Shearer, on page 897 of *Engineering News-Record* of Nov. 8, 1917, it seems to some of us a useless effort to attempt to control to any extent the signification which shall attach to this word. Words have such an obstinate way of following the usage of the uninformed masses of the speaking population that the technical minority can usually do little to write into them any special meaning. All will recall the many newspaper attempts in the late '90s to coin a shorter term than "automobile," but though "auto" will possibly be recognized by the next generation as good English—as good, for instance, as "lunch"—it will not be due to any concerted efforts of the automobile manufacturers.

Mr. Shearer makes an excellent point in stating that no engineer is "consulting," in the strict sense of the word, all the time. Probably no engineer in private practice would be unwilling to accept a commission as consultant to a brother engineer whenever he felt that his advice would be of value, and few indeed are the engineers in this country who confine their practice wholly to advising with other engineers already retained on the work and who would refuse to organize the engineering forces of any piece of work which appealed to them in their own special lines, naming their immediate juniors on the project and working for the so-called "owner" in much the same legal relationship as his less eminent brothers do on smaller projects. These few men are compensated for any degradation which may attach to their title of consulting engineer by their eminence in the profession and by the size of their fees. Are they not as well off without any new and strange technical term which would label them as fundamentally different from their brothers?

In the legal profession a "counsellor" is retained to serve his "client" direct, exactly as the average "consulting engineer" is retained when he sells his best engineering advice direct to the "owner" of the project in which he is engaged. "Counsellor" is a rather general term in this country, and under it many lawyers try out cases before the courts, even though they never call themselves "barristers." The difference between the two is said by one of our local counsellors to be the same as that between a goat and a bulldog—one fights with his head, the other with his mouth. This suggests a point of similarity between the consulting engineer and his junior out on the job—a good man fights both ways.

In the engineering profession we have already a confusingly large number of special terms to designate the branch which each engineer prefers to follow; for example, hydraulic engineers, sanitary engineers, electrical engineers. Why waste ink and energy in trying to coin another? May we not borrow from the idea of the Chicago park commissioner of sainted memory, whose plan for securing a fleet of gondolas was to import two, male and female, and "let nature take its course." Is it not a perfectly natural usage to apply the word "consulting" to an engineer in private practice who may be consulted by any client who requires his counsel, or advice, or professional services, and would not the profession be better advised to "let nature take its course"?

CONSULTING ENGINEER.

Road Types in War Zone

Sir—I read with considerable interest the article on macadam roads in the war zone by William J. Weir, which appeared in your issue of Sept. 13, 1917, p. 489, and also the numerous letters of comment that it called forth.

It seems to me that there are several points that the article as well as the comments failed to bring out:

(1) The macadam road (plain) is not the only type in use; (2) although the arguments presented in favor of the macadam roads certainly do apply in the forward areas where the danger of shell fire is always imminent, they do not apply in the back areas. The problem here resolves itself into providing a satisfactory road with the material available and one capable of carrying the traffic.

The other type of road in use consists of macadam base with a bituminous wearing surface. There is at least one important road of this kind on the western front, and it successfully carries a traffic of the most trying nature. It does not seem to require the excessive maintenance work that Mr. Weir reported for the macadam roads. The wear and tear on equipment using this road must be considerably less than is the case with macadam. It certainly gives a smooth-riding and dustless surface.

WALTER C. CAREY.
Company C, 14th Engineers, American Expeditionary Force in France.

Stopped Drainage Work Which Would Pay for Itself in Two Years

Sir—The drainage project of Drainage District 1 of Tama County, Iowa, was abandoned by request of the interested property owners on the ground that the Government expects everyone to conserve. In this action sight was lost of the fact that the Government puts the increase of food production first in importance. The total cost of the drainage project could have been paid for out of the increased crop production in about the first two years—the first year if it should happen to be wet. The writer believes that economy should be practiced, but there is no use in robbing Peter to pay Paul.

A. R. HEBENSTREIT.
Toledo, Ohio.

Awakening Recognition of the Engineer

Sir—One of the most interesting articles which have appeared in your paper for some time is the extract from Fraser S. Keith's address to the Canadian Society of Civil Engineers, printed in your issue of Dec. 27, 1917, p. 1206. It is this type of article, advocating recognition of the engineer, that the young engineer needs. It causes him to take a different attitude toward his work, an attitude which in time will develop a new engineer. Let us have more such articles.

Goshen, Ind. O. B. KERCHER.

Employment Activities of Engineering Societies

Sir—With reference to your comment in the issue of Jan. 24, p. 183, entitled "Employment Activities of Two Societies," I take pleasure in calling your attention to a copy of the December issue of the "Providence Engineering Society" which describes the tentative establishment of an employment bureau for the benefit of our members. We have already had a number of replies, both from men desiring employment and from members who are in a position to employ engineers, and I believe that this bureau will become a permanent feature.

Early last year we considered the thorough listing of qualifications and engineering experience of our members. We accordingly prepared an elaborate classification blank for the purpose, but soon after this one of the national societies and also the local Public Safety

Committee issued similar blanks which differed widely and all of which contained subjects for a more comprehensive enrollment than that which we originally planned. Accordingly we kept postponing the printing of our blank in the hope that we could eventually include all the information which the new war condition had made it most desirable to obtain. So far conditions in general have been so chaotic that we have again postponed the making up of this classification. So many people are receiving requests to do so many things out of the ordinary that we feel it would be difficult to obtain a sufficient number of complete responses to make the plan a success. We will, however, be greatly interested to note in your columns the results which other local societies are securing along this line.

R. W. ADAMS,
President, the Providence (R. I.) Engineering Society.
Providence, R. I.

Standard Multiple and Alley Inlets Used at St. Louis

Sir—I wish to express my recommendation of the article on "Efficiency of Storm-Water Sewers Depends on Inlets," in your issue of Jan. 10. Mr. Kane has described a defect in sewer design work which is quite common throughout the country and which, as he says, produces flooding and damage quite as serious as would be caused by insufficient sewers.

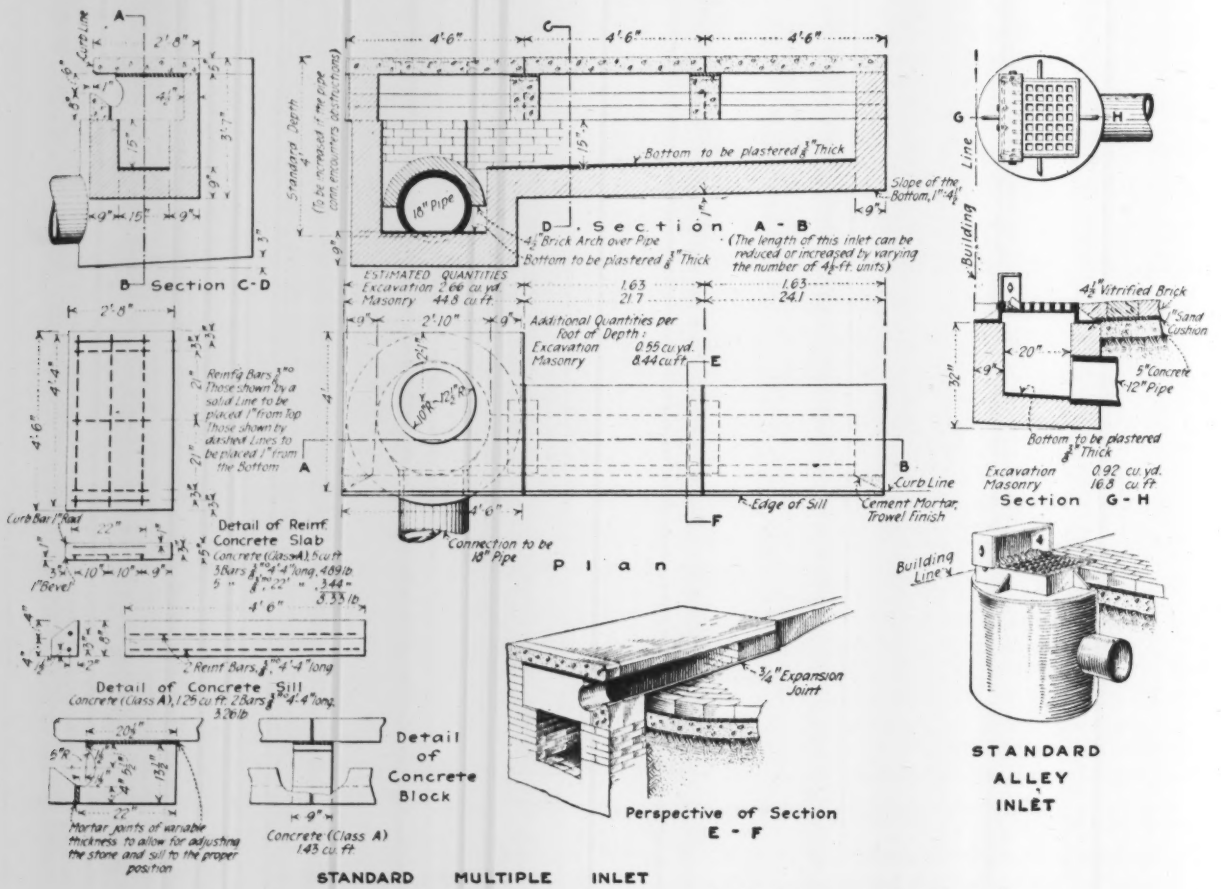
Recent investigations and studies of the older sewers of St. Louis have shown that in almost all cases the inlets and the paving around them are improperly worked out and that during heavy storms large streams of water pass one inlet after another and finally cause serious flooding at the bottom of the hill. Where this condition is being relieved, and also in the new work, we are now using inlets of various sizes with special facilities for receiving the water.

We have noted particularly one fact which Mr. Kane mentions, that it is difficult to turn the gutter stream into the inlet, and we have found that where the stream has a good velocity it is impossible to turn a material proportion of it into an inlet with the face opening of 3 to 4 ft. length ordinarily used. The change of direction in this length is very small, while the change of direction in an additional 4 ft. would be several times as great. To meet this condition our new inlet has been designed in units which may be multiplied indefinitely. Details are shown on the accompanying plans.

We estimate the cost of the single inlet 4 ft. deep complete, but exclusive of pipe connections, at $30 with $15 extra for each additional unit.

W. W. HORNER,
Chief Division of Design for Sewers and Paving.
St. Louis, Mo.

[The single blueprint sheet sent by Mr. Horner is here reproduced as illustrating not only the point in question but also a most interesting example of designing detail—Editor.]


Section C-D
Section A-B
Plan
Section G-H
Detail of Reinf. Concrete Slab
Detail of Concrete Sill
Detail of Concrete Block
Perspective of Section E-F
STANDARD ALLEY INLET
STANDARD MULTIPLE INLET
Bottom to be plastered ⅜" Thick
18" Pipe
Curb Line
Edge of Sill
Cement Mortar, Trowel Finish
Connection to be 18" Pipe
Building Line
¾" Expansion Joint
Mortar joints of variable thickness to allow for adjusting the stone and sill to the proper position
Concrete (Class A) 1.43 cu. ft.

ST. LOUIS USES STANDARD MULTIPLE AND ALLEY SEWER INLETS

Work of Advisory Council on Labor of Greatest Importance to Industry

Body Will Formulate Program and Recommend Administrative Machinery in Every Phase of Employment Problem

Washington Correspondence

UNTIL within a month the most discouraging fact to those looking on in Washington was the lack of any indication of broad consideration of the labor problem. The President's speech before the American Federation of Labor set forth no constructive policy. It was a patriotic appeal. The Department of Labor was dealing with industrial disputes as they arose, but there was no expression of fundamentals. The direct parties to the controversy—employers and employees—were pulling apart instead of being drawn together. Apparently, as far as official Washington was concerned, we were to be allowed to come to an impasse without any effort on the part of the Government to compose the difficulties.

Within two weeks there has been a most remarkable and a most welcome change. Today machinery is in motion which will bring the contending interests together on a broad basis. Light has broken. Hope has succeeded the discouragement of last month.

The first official recognition of the need for a broad consideration of the problem was the appointment of an Advisory Council to the Secretary of Labor. This appointment, far more important, broadly speaking, than many of the problems which have occupied front-page space, was hardly noticed in the public prints. Yet that council is expected to determine the policy which shall keep labor and capital working together during the war. More than this, if its work is farseeing—as the constitution of the Council gives warrant for expecting—it should have a tremendous, if not the determining, influence on the socio-economic conditions under which we shall live after the war. To industry, therefore—yes, and to labor, to the country at large—the establishment of the council is easily the most important event since the beginning of the war.

Lest this estimate of the importance of the council be considered extravagant, it will be well to set down here the work outlined for it. It will consider the establishment in the Department of Labor of agencies to perform the following functions:

1. A means of furnishing an adequate and stable supply of labor to war industries. This would embrace: (a) Satisfactory system of labor exchanges; (b) a satisfactory method and administration of training of workers; (c) an agency for determining priorities of labor demand; (d) agencies for dilution of skilled labor as and when needed.

2. Machinery which will provide for the immediate and equitable adjustment of disputes in accordance with the principles to be agreed upon between labor and capital and without stoppage of work. Such machinery would deal with demands concerning wages, hours, shop conditions, etc.

3. Machinery for safeguarding conditions of labor in the production of war essentials. This to include industrial hygiene, safety, women, child labor, etc.

4. Machinery for safeguarding conditions of living, including housing, transportation, etc.

5. Fact-gathering body to assemble and present data collected through various existing Governmental agencies or by independent research to furnish the information necessary for effective executive action.

6. Publicity and educational division which has the function of developing sound public sentiment; securing an exchange of information between departments of labor administration; and promotion in industrial plants of local machinery helpful in carrying out the national labor program.

The first four divisions cover matters familiar to all manufacturers, contractors and engineers. Subdivisions b, c and d of function 1 represent activities made necessary by the war. The true significance of the establishment of the body is appreciated when attention is directed to the sixth division, and when we recall the activities of the labor division of the British Ministry of Munitions and the influence that its work of the same broad scope has had on industrial England. What can one not read into "the function of developing sound public sentiment" and "promotion in industrial plants of local machinery helpful in carrying out the national labor program"—such program obviously being comprehended in the determination of the first four divisions of the program. One may expect that the "developing of a sound public sentiment" will necessitate the statement of the fundamentals for industrial and labor prosperity—a difficult task, but one whose performance would be of the greatest value.

If further evidence is needed as to the possible influence of the Council, it is furnished by its action last week in recommending to the Secretary of Labor (1) the organization of a board which will formulate an arrangement for ending strikes and (2) the centralization in his department of the industrial service divisions of the various branches of the war machine. Both plans have been approved by the secretary. The first of them is absolutely essential if coöperation is to replace strife.

The personnel of the Council, as has been said, gives warrant for expecting far-reaching results. It is headed by John Lind, former governor of Minnesota and envoy to Mexico, representing the public. Waddill Catchings, president of the Sloss-Sheffield Steel and Iron Co. and of the Platt Iron Works, and A. A. Landon, general manager of the American Radiator Co., represent the employers. Labor's members are John B. Lennon, treasurer of the American Federation of Labor, and John J. Casey, former member of Congress. Dr. L. C. Marshall, of the University of Chicago, is the economist

member and Agnes Nestor, of Chicago, represents women.

The Council's duty is not merely to formulate a program, but to recommend the machinery for putting it into effect. That it believes in action is shown by its two public acts within ten days after its organization. Industrial leaders will be impressed by that evidence of virility and will follow closely the further activities of the body.

Sewers Built in Wet Trench in Dead of Winter

Low Labor Cost Offset by Coal Outlay To Heat Materials—Double Sheeting and Double-Ring Segmental Blocks Used

By Roscoe E. Sawistowsky
City Engineer, Davenport, Iowa

TWO new outlet sewers have been made necessary at Davenport, Iowa, as a result of river-front improvements. A double ring of segmental blocks backed with concrete to well above the springing line was used for each sewer. Wet trenches made portions of the work difficult.

Building a levee at the Federal harbor line some years ago reclaimed a considerable area of land but so affected the river current as to fill in a large part of the depth of the river channel between City Island and the mainland. This necessitated joining into the two new outlet sewers already mentioned seven sewers which had been discharging into the channel at the foot of as many streets and extending the new outlets

STREATOR DOUBLE-RING SEGMENTAL BLOCKS USED

across the old channel and the island to the main channel of the Mississippi River.

Only a few hundred feet of new sewers were required in each case. One of the sewers was 60 and another 78 in. in diameter. The contractor was the D. E. Keeler Co. Streator segmental block were used.

On portions of the work the river surface was about 2 ft. above the grade of the sewer invert and water rose within the cofferdam to that level.

The contractor first drove two rows of 2 x 12-in. sheeting, in 8-ft. lengths, 9 ft. apart, using 4 x 4-in. cross braces. The men worked in rubber boots in from 1 to 2 ft. of water, casting the dirt from the trench with long-handled shovels. When the bottom was excavated to the proper grade, 3 x 12-in. plank, 9 ft. long, more or less (the neat width between rows of sheeting) were laid on the bottom and secured with a cleat on each end to the sheeting. The form for the shaping of the concrete base was a half circle the diameter of the inside of sewer, plus the thickness of the blocks, and plus ½ in. which was allowed for mortar to bed the block in. The blocks laid up 6½ in. thick for both the 60- and 78-in. sewers.

The forms were set to the required grade and securely braced to prevent their being raised up by the tamping of the concrete under their lower quarters. The contractor had an expensive experience with one section of form, which, not being securely held down, raised about 6 in. at one end when formed. After the form was removed the concrete above the proper subgrade for the blocks had to be picked and chiseled away.

The work was carried on successfully through the dead of winter, labor then being more plentiful and cheaper than it would have been the next spring when other construction work was on the boom. The contractor, however, spent approximately $3000 for coal for heating materials that would not have been necessary had he waited several months. This was as much as he saved on labor.

The work was carried on under the board of public works, of which J. W. Crowley is commissioner and the writer city engineer.

Governmental Housing Plans Fast Taking Shape

Conference of Executives Decides To Let Each Department Take Care of Its Own Problem—Constructive Program To Be Put in Force Immediately

REPORTS from Washington indicate that the Government's interest in the housing of workmen in the various war industries is growing slowly, in the view of those who have been there for months urging immediate action, at least with some expectation of expedition. While the centralization of all governmental housing activities seems for the time to be defeated, there is good reason to believe that a centralization in effect, if not in form, will eventually develop. Meanwhile the three main departments concerned—the Army, the Navy and the Shipping Board, have each started on a definite housing program.

Early in the year the Council of National Defense established a Housing Committee, headed by Otto M. Eidlitz, a well known New York builder, to look into the whole question of government housing. This committee conducted extensive investigations, utilizing also some previous studies made for the Government by Philip Hiss, a New York architect. Like all other committees of the council, the Housing Committee's powers were only advisory, and while it undoubtedly proved of service to the departments contemplating arrangements for sheltering workers, its constructive work was not very great.

Meanwhile the need for housing at the large shipbuilding and munitions centers became imperative. Work was actually being retarded for lack of workmen because of the low grade or entire absence of housing,

and costs were increasing, due to the reaction of high boarding and lodging charges on wages. Those in authority, however, were slow to venture deeply into the novelty of government aid or initiation of house building for fear of raising the "socialism" or "paternalism" bogy. Some efforts were made to tabulate the facilities existing in certain congested districts and some tentative plans were advanced and in one case executed for the new shipyards, but the great and necessary expenditures were delayed to await the growth of public sentiment. This sentiment was gradually increasing when Homer L. Ferguson made his forceful and effective plea for aid at his shipyard at Newport News, and the awakened Senate committee which had heard him urged, with the effectivness of an order, the appropriation by the Shipping Board of $1,250,000 for that purpose. This proved to be the needed spur to further action. The Shipping Board proceeded to allot more funds to projects already designed or under way and had a bill introduced into Congress appropriating $50,000,000 for shipyard housing alone.

In the meantime the Department of Labor had been investigating the whole problem of industrial housing and had decided that the expenditure of government funds for this purpose should come under its direction. Accordingly a bill was prepared vesting in the Department all government housing powers. It is also understood that there was talk in some high quarters of establishing a Housing Board, similar in powers and makeup to the Shipping Board, with independent control of the whole matter. Obviously, some fusion of these various proposals had to be made if Congress were to be persuaded to appropriate funds. The different interests, therefore, came together last week in a conference at which were several Cabinet officers or their representaitves, and the chairmen of the Congressional committees controlling the proposed appropriations. At this conference it was definitely agreed that there would be no centralized control of all governmental housing vested in any one department or body, but that each branch of the government should take charge of its own housing work.

On the basis of this arrangement, therefore, the War Department, the Navy Department and the Shipping Board are each to have housing administrations, spending separate appropriations on separate work. The Shipping Board's proposed bill allotting to it $50,000,000 is expected to go through Congress very soon, and the two departments will probably be able to divert funds already appropriated to such housing needs as come up. Although it looks as though under this scheme there would be no central control of the Government's housing program, there is a very good chance that such necessary and desirable control will be brought about by the establishment of a small board composed of three men, representatives of each of the three branches now at work on government housing, who will act as an administrative head of the work, leaving the detailed execution to the experts in the several departments. No official intimation of the formation of such a board has, however, been given.

Meanwhile the committee of the Council of National Defense continues to act in an advisory capacity, being tied up more closely to the Shipping Board, in whose offices it now has quarters, than to the Army or the Navy. The Board has appointed J. Rogers Flannery, a Pittsburgh business man, as head of its housing work and he, with the assistance of Mr. Eidlitz' committee and its offices and drafting force, is working at forced draft on the new housing projects at the shipyards. These comprise government owned and controlled industrial towns such as the one at Bristol, Penn., described in last week's issue of *Engineering News-Record* and, for the private plants, the erection of houses, the loaning of money to accredited business interests and the development of existing housing and transportation facilities, all depending upon the exigencies of the particular yard. Announcement of the detailed plans may be expected soon.

The War Department, whose housing problems are mainly around the munitions towns, has delegated housing authority to the Ordnance Department. There in the Industrial Service Section, under Dean Herman Schneider of the University of Cincinnati, the execution and planning of the housing program is in charge of Perry R. MacNeille, the New York architect who was also consulting architect for the Shipping Board in the Bristol housing scheme. This section of the War Department and the corresponding section of the Navy Department, which is not so well organized as yet, are working in close harmony with the Labor Advisory Council of the Department of Labor.

Concrete Ships Are Being Built by the United States

Shipping Board Has Organized a Division To Study Problem and Has Let Contracts for Several Vessels

THE United States Shipping Board several weeks ago decided to begin the construction of large ocean-going self-propelled concrete ships. Following a long investigation of the possibilities of this type of marine construction by the United States Bureau of Standards and the Shipping Board, the latter body on Dec. 27, 1917, formed a Department of Concrete Ship Construction, which has already developed a considerable organization. This organization, which is being built up around the one started by the Bureau of Standards, is studying the problems of concrete-ship design, is checking over such designs as are submitted to it by outside engineers and has recommended and had approved by the board the letting of several contracts for the construction of concrete ships.

A corps of designers is engaged in the development of a standard design for a reinforced-concrete ship of approximately 3500 tons deadweight cargo carrying capacity. In this study an original investigation is being made into the moments to which an oceangoing vessel is subjected, as a result of which the stresses are analyzed and the design made. The complete drawings and specifications for this ship are expected to be ready about Mar. 1, at which time bids will be asked from certain selected contractors.

This same designing force is also supervising the design of the ships already contracted for. The board requires that plans and specifications for all such con-

tracts must be approved before construction is started. It is reported that satisfactory progress is being made in this work. In addition the board considers any design submitted by other persons, although so far no complete design for a reinforced-concrete ship has been submitted. Many suggestions as to details, however, have proved useful to the designing force.

Three Contracts Let

Three contracts have been let. These are to the Liberty Shipbuilding Co., of Boston, the Fougner American Steel Concrete Shipbuilding Co., of New York, and the Ferro Concrete Shipbuilding Corporation of New York. All three contracts are provisionally for a number of ships but are contingent upon the seaworthiness and satisfactory character of the first ship built, which building will be under the direction of the Shipping Board. A fourth contract is under negotiation with the firm building the 5000-ton ship at San Francisco, which was illustrated in *Engineering News-Record* of Jan. 17, p. 105. The tree first contracts are for 3500-ton ships, but the contemplated San Francisco ship is to be a 7500-ton vessel, by far the largest concrete ship ever attempted. The present program of the board, therefore, contemplates the construction of five large concrete ships of different design. These ships will all be in the nature of experiments, and upon their success or failure will depend the future of the Government's concrete-ship construction.

The design of all but the 7500-ton ship is such that the boilers, machinery and fittings of the Government's standard wooden ship can be used. Such fittings will be available for installation when the concrete hulls are launched. The Shipping Board has let contracts to a number of well-established plants and yards at which the assembling and fitting out of the wooden ships is to be done. These yards are convenient to the yards where the concrete hulls are to be made, and those hulls will be towed to the fitting-out yards as soon as launched, there to be completed for service.

Tests Being Conducted

In addition to the work set forth above, the board is conducting a number of tests, which are being made under the direction of the Bureau of Standards. It is also coöperating with the United States Steamboat Inspection Service and Lloyd's Registry, both of which bodies have detailed engineers to coöperate with and assist the board. An officer of the Bureau of Lighthouse is also giving some coöperative service. It is expected, too, that the question of concrete barges for harbor and inland waterway transport will soon be taken up with the various governmental bureaus concerned with that work.

The Department of Concrete Ship Construction is under the direction of James O. Heyworth, of the United States Emergency Fleet Corporation, with Rudolph J. Wig, of the United States Bureau of Standards, as chief engineer. The organization includes Lewis J. Ferguson, as assistant chief engineer, Robert W. Boyd, of New York, as consulting concrete engineer, and W. A. Slater, of the University of Illinois, as concrete engineer. Other concrete designers and constructors and naval designers are being brought in as quickly as possible. Every effort is being made to expedite the work sufficiently to put the experimental ships in the water at the beginning of warm weather, so that should they prove successful, quantity production can be well under way by the middle of summer.

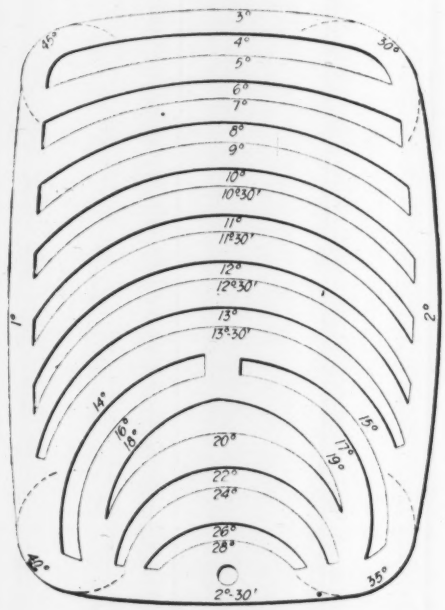
A Single Templet for Many Curves

By R. T. Brown

Assistant Highway Engineer, South Carolina State Highway Department, Columbia, S. C.

A connected set of curves made by the writer has been found very serviceable. The draftsmen in those offices in which the curves have been used seem to prefer them to either the beam compass or individual celluloid curves, as it is easy to find a curve to fit the conditions.

The curves were cut from a sheet of celluloid. The sheet was fastened to the drawing table with tacks. The removable leg of a beam compass was then taken off and a sharp marker made of metal substituted. With this, grooves were cut into one side of the sheet. The latter was then turned over and carefully centered



THIRTY-THREE CURVES ON ONE TEMPLET
The figures show a suggested arrangement for the curves, but are of course not to scale

over the line before used as the locus of centers. After grooves were again cut as deeply as convenient with the improvised point the sheet was broken easily along the lines by bending back and forth.

Curves of the same radii were drawn on a sheet of white paper with a fine line. The curves were sandpapered with a fine grade of sandpaper fastened on a block. While being sanded they were repeatedly tested as to accuracy by the curves drawn on the white sheet.

These curves are of sufficient length to fit any ordinary conditions, as the sharper curves, which are the longer, will generally be used with the larger values of delta.

Any draftsman with a little care and patience can cut out such a set, using the scale and particular curves best suited to his usual run of work.

HINTS FOR THE CONTRACTOR

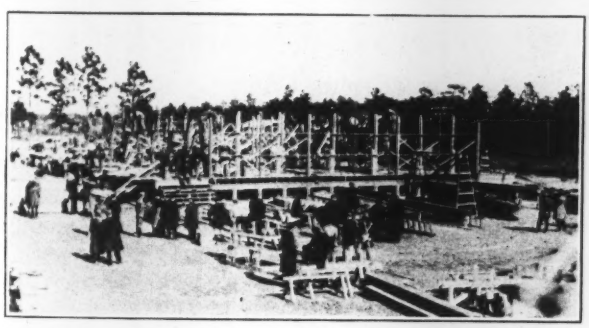
DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Build Big Warehouse in Less Than Three Hours at Camp Johnston

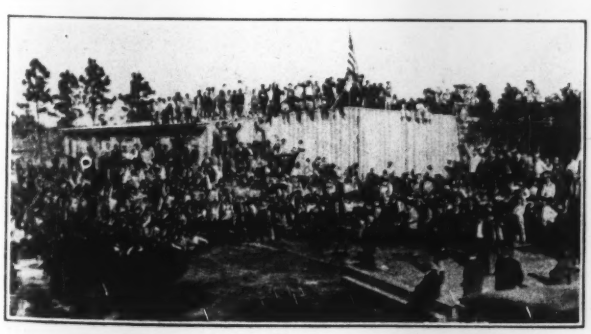
BY C. H. HOLLINGSWORTH
General Superintendent, A. Bentley & Sons Co., Camp Joseph E. Johnston

AT CAMP Joseph E. Johnston, at Black Point, near Jacksonville, Fla., on Dec. 10, a warehouse 60 x 150 ft. was erected complete in two hours and fifty-five minutes. This warehouse is a fairly heavy building, one story high. The foundation posts and mud sills for it had been set and the sills for the building were ready cut. It was the second of two warehouses and one of the last buildings in this camp to be completed, and as part of the material for it had been held up the building was behind the schedule.

10:50 A.M.—ALL MATERIAL IS READY FOR THE START



11:25 A.M.—JOISTS AND PART OF STUDDING PLACED



1:45 P.M.—"MOVIES" MARK THE FINISH OF THE JOB

The working gangs were moved to the building at 10:50 a.m., and it was completed and roofed and the doors were hung at 1:45 p.m. The pictures show the progress of construction. There is in round numbers 104,000 ft. b.m. of lumber in the building. The entire force working on it, including roofers, numbered 280 men. The sills are 8 x 13-in. timbers and exactly three minutes after starting work they were all set, while seventeen minutes after starting all the floor joists were in place. Enough of the floor was laid so that the posts could be erected and the remainder was laid while the building was being closed in.

There was no rehearsal or drilling of the men and no picking of individuals or gangs, but all material was on hand. Camp Joseph E. Johnston is a quartermaster's training camp which will accommodate about 20,000 men. It is being built for the War Department by A. Bentley & Sons Company, of Toledo, Ohio. The writer is general superintendent, and F. J. Carew is superintendent of building construction.

Boat Channel Dug Through Bar in Creek with Dynamite

BY W. A. SANDERS

CONFRONTED with the problem of deepening the channel of the Maconia River, in New Hampshire, so boats could be taken above a shoal where the water was already too deep for scraper or hand excavation, the writer made use of dynamite with success, although the material displaced had to be lifted through the water and thrown out on the banks.

The channel required was 320 ft. long. A first test shot with three sticks spaced 2 ft. apart lying on the surface of the gravel and mud bottom raised nothing but water. The charges were then put down into the gravel about 12 in., and spaced at 2 ft. intervals. When fired, the shots hurled the mud and gravel clear up on the banks, and blasted a channel about 5 ft. wide and 2½ ft. deep, which gave enough clearance for the small boats it was desired to take up the river.

Convert Ford "Locomotives" from Narrow to Standard Gage with Success

HOME-MADE trucks for standard-gage track were recently built by the Southern California Edison Co. and fitted to receive a Ford automobile engine as the motive power. The engines were those previously used by this company on 24-in. gage trucks at Huntington Lake, where they handled last season 130,000 cu.yd. of concrete in trains of three 1-cu.yd. cars. The trucks

HOME-MADE TRUCK ON 18 PER CENT. GRADE

were described in *Engineering News-Record* for Dec. 13, 1917, p. 1120.

The engines are said to be doing as well on the standard-gage trucks as on the narrow-gage, and the engineer says that they were easy to build and are easy to repair and maintain. The frame of the truck proper consists of steel I-beams and the drive can be any one of the transmissions now sold for converting a Ford pleasure car into a truck, driving from an intermediate shaft by chains to sprockets on the truck axles.

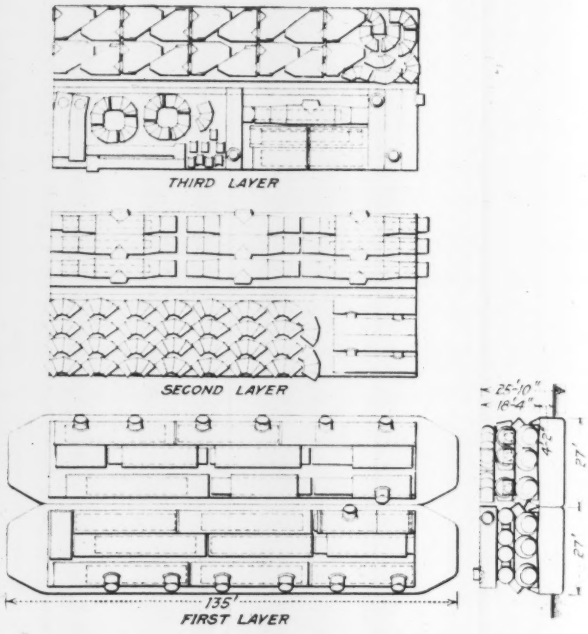
In the illustration one of these trucks is shown without ballast on an 18% grade, which it climbed with ease. The length of this incline was 400 ft. The truck climbed to the top without hesitation and when it reached the summit was still traveling at a rapid rate.

Trucks of this type have been built and operated with success on 18-in., 24-in. and standard-gage track for work on the Southern California Edison Co. system by R. C. Starr, hydraulic engineer for the company.

Load Pair of Barges 26 Feet High with Pipe

An unusual load of large fabricated steel pipe was recently shipped down the Ohio River on two barges fastened side by side, making a load 26 ft. high. It took this tow from Sunday night to Thursday morning to reach Portsmouth, Ohio, from the Neville Island plant of the Dravo Contracting Co., which fabricated the pipe. The steel plates used were furnished by the Whitaker-Glessner Co., for whom the pipe was made. They had been shipped by rail from Portsmouth and the cars had taken from three to five weeks to make the trip on account of freight congestion.

The two 600-ton decked barges were lashed together to make them safe in a wind storm, and give stability for towing. Although many of the sections were nested and telescoped, and the total weight, 320 tons, was well below the capacity of the scows, it was necessary to make the load three tiers high. After the last section had been placed, the top of the strange tow stood 26 feet above water.



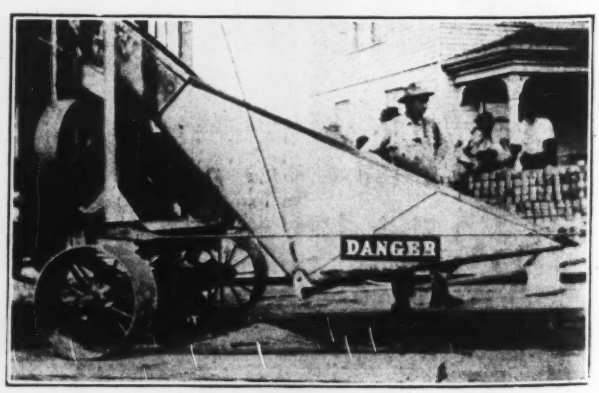
IRREGULAR SECTIONS MADE LOADING DIAGRAM NECESSARY

The whole was staked, blocked and wired like an exaggerated flat-car load, and made the long trip without displacement or accident.

Guard Saves Men from Walking Under Descending Charging Skip

By W. F. Reichardt
Consulting Municipal Engineer, Watertown, Wis.

On the writer's work where a mixer of the type shown in the photograph is used, there was always trouble in keeping the men from walking underneath the falling hopper as it was being lowered after dumping a batch into the mixer. The simple precaution shown in the photograph was placed on this paving mixer by Sweeney Brothers, contractors of Reedsburg, Wis., on a



RODS PREVENT MEN WALKING UNDER SKIP

paving contract under the writer's supervision carried out last year at Princeton, Wis. Although the arrangement would appear to be obvious, the writer has never seen a similar one in use.

The guards, as can be seen, are inexpensive, and easily attached to the machine.

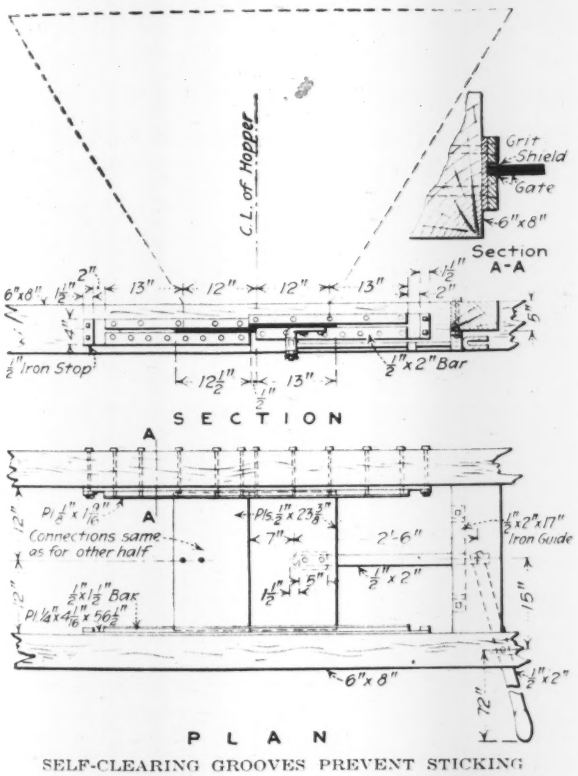
Knife-Edge "Grit Shield" on Top of Hopper Gate Prevents Trouble

By John H. Sawkins

Jersey City, N. J.

A HOPPER gate in use on one of the large floating concrete mixing plants belonging to Henry Steers & Co., Inc., is built so that it does not stick from sand or fine gravel catching in the side grooves, and has given satisfactory service.

As shown in the drawing, the ½-in. plates forming the lower slides for the double leaves of the gate are separated by ½ in. at the center to allow any grit which may accumulate in the groove to drop out. The iron stops are placed 2 in. from the back ends of the grooves for the same reason. The gates themselves are ½-in. iron plates placed so that they overlap each other 1 in.,



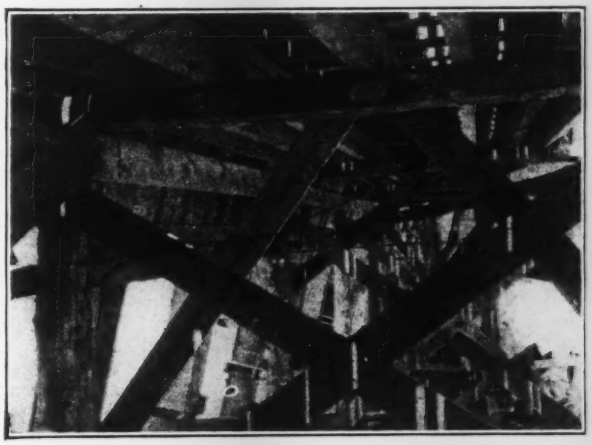
SELF-CLEARING GROOVES PREVENT STICKING

which prevents any gravel being caught between the two plates when the gate is closed.

The accumulation of grit in the groove is reduced to a minimum by a "grit shield" having a knife edge which bears on top of the gate leaves, as shown in the small detail drawing. The ¼-in. plate forming the back of the slide on each side prevents the leaves of the gate from cutting into the timber when there is a diagonal pull on them, resulting from the connecting rods making an angle with the center line of the leaves.

Temporary Trestles Stiffened by Twisted Wires

IN THE work of increasing the height of dams at Huntington Lake, California, high trestles, on which to convey materials, had to be built over the structures. When these trestles had been constructed, it was decided



WIRES REDUCED VIBRATION AND WORKING OF JOINTS

that the use of a considerable quantity of old wire which the company had at the site would be an inexpensive method of reducing vibration in the trestles and increasing their stability. Accordingly, the wire was cut into suitable lengths, put in place between stringers and diagonally across the tops of bents, and twisted taut. This work was done by common labor, under the direction of a foreman who pointed out the places where wires should be stretched. No prearranged system of attaching the wires was followed, the foreman simply using his judgment. The accompanying photograph, taken under one of the trestles, shows the wires in place.

Engineers Want Reclamation Fund for Oklahoma

Modification of allotments for the Federal reclamation fund is proposed by the Oklahoma Society of Engineers in an amendment to the Chamberlain reclamation bill now before Congress. Under this plan an amount equal to the contribution of any state to the Federal fund will be allotted to that state for the construction of irrigation, drainage and flood-protection works. From this amount would be deducted any allotments from the Federal fund prior to June 30, 1917, for work in that particular state.

Unequal allotments from the Federal fund to the several states which have contributed to this fund is the reason for the proposed plan. There is no criticism of previous practice, it being recognized that allotments where the largest results were obtainable were well justified. The plan applies particularly to six states, California, Kansas, North Dakota, Oklahoma, Oregon and South Dakota. It is pointed out that while Oklahoma alone has contributed $5,800,000 to the Federal reclamation fund, most of this has been spent in other states, and Oklahoma now wants about $5,662,800 for reclamation works within its own boundaries.

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Professional Unity Advanced by Ohio Conference

Forms Association of Ohio Technical Societies—Endorses Ten Cardinal Coöperation Principles

EDITORIAL CORRESPONDENCE

Enthusiastic desire to bring about professional unity in the State of Ohio was the outstanding feature of the conference of engineering societies of that state held at Columbus, Jan. 29. The meeting resulted in the formation of a permanent organization, the Association of Ohio Technical Societies, with Clyde T. Morris, professor of civil engineering of Ohio State University as president and C. E. Drayer, of Cleveland, as secretary. Every local society and local section of the national societies in the state was represented except one local society, whose absence but emphasized the belief of the engineers of Ohio in unity.

Delegates numbering 20, representing 10 societies, gathered in the library building of the university.

In discussing the subject of coöperation and the organizations to be included in the state association, the opinion was expressed by the representative of the Columbus chapter of the American Institute of Architects that the work of both architect and engineer would be improved if each made use of the special training of the other. An illustration was found in the concrete bridges over the Scioto River, in Columbus, where the combined efforts of members of the two professions resulted in a commendable design. The unfortunate experiences of engineers and architects in Illinois in furthering laws regulating practice were discussed, and decisive assent was voiced by the delegates to the suggestion that architects be welcomed in the "get-together" movement in Ohio.

Resolutions were passed indorsing the 10 cardinal principles adopted by the Committee on Engineering Coöperation at its conference last March; urging local societies to endeavor to have at least one engineer named on any board having to do with the expenditure of public funds where engineering experience would be of assistance; and indorsing the report of the inter-society relations committee of the Cleveland Engineering Society suggesting that the national societies consider as a prerequisite to membership that a candidate show membership in an accredited local society.

Employment, legislation, participation in civic affairs and statutory regulation of engineering practice were discussed, the last named at length.

A delegate from Cincinnati who employs some 70 engineers advanced the need for information determining how much each class of engineering work should be paid. He wished to pay what the work was worth, but had no means of knowing what that was except when someone tried to take men away.

All delegates seemed to recognize that regulation by law of the practice of engineering was coming. If engineers did not recognize this situation and draft the laws themselves, others would do so.

These questions and others will be placed in the hands of committees for consideration and report after the societies constituting the conferences have heard the reports of their delegates and approved the central organization. Provision was made for sufficient funds to meet the expenses for the coming year.

Now a New Commission for New York's West Side Problem

Repeal of existing laws regarding New York City's West Side freight problem, and the appointment of a new commission to handle the matter, are embodied in the report of the special Commission on West Side Improvement, which was submitted to the state legislature Jan. 31. The commission proposed would consist of the mayor and comptroller of New York City, *ex officio;* two members, designated by the governor, of the Public Service Commission; and three additional persons to be appointed by the governor.

The report recommends certain elements as desirable in any plan to be adopted. They include a subway or elevated terminal system from Sixtieth St. to Canal St., open to all railroads, and one or more tunnels under the Hudson River to connect with the yards in New Jersey. North of Sixtieth St. the treatment proposed is very similar to that recommended last fall by the joint committee of the Board of Estimate and the Public Service Commission.

Minnesota Road Activities on Arterial Routes Only

The policy of the Minnesota Highway Department in its coöperation with the counties during 1918 has been agreed upon, and will result in a concentration of effort upon main arterial highways, with a total slighting of the miscellaneous and general improvement of roads of less importance. With its main policy will be coupled an intensive system of maintenance of all the roads of the state. The trunk-line traffic has developed to such an extent that the state cannot afford to withhold the necessary improvements to fit such roads for the traffic to which they will be subjected. All this means that a higher class of construction will have to be instituted, and, even if the cost of labor and materials is unusually high, it is felt that there is no reasonable prospect of a noticeable decrease in cost within the next three years—and the roads must be taken care of immediately.

Canadian Civil Engineers' Society Changes Its Name

Will Be Known Hereafter as Engineering Institute of Canada—Holds Convention in Montreal

The annual convention of the Canadian Society of Civil Engineers was held at Montreal, Jan. 22 and 23. Col. C. N. Montsworat occupied the chair. The principal paper was read by B. F. Haanel, chief of the division of fuels and testing, Department of Mines, Ottawa. His subject was "Fuels of Canada," and he dealt with the gravity of the fuel situation, pointing out that Canada was at present dependent on the United States for her coal supply. He urged that the lignite and peat resources of Canada should be utilized, in order to make the country self-supporting in the matter of fuel.

The name of the society was changed to the "Engineering Institute of Canada." The following officers were elected: President, Henry H. Vaughan, Montreal, vice president and general manager of the Dominion Bridge Co.; vice presidents, T. H. White, Vancouver, B. C.; J. M. R. Fairbairn, assistant chief engineer, Canadian Pacific Ry., Montreal; Prof. H. E. T. Haultain, University of Toronto, and R. F. Hayward, of the Western Canada Power Co., Vancouver. Mr. Vaughan, the newly elected president, is an Englishman by birth and went to the United States in 1891. After occupying important positions in connection with American railways he went to Canada in 1904 as superintendent of motive power of the Canadian Pacific Ry. Lines East. A year later he became assistant to the vice president, with charge of the Angus shops, Montreal, and the car and locomotive equipment. Subsequently he became president of the Montreal Ammunition Co. and the Dominion Copper Products Co., and when these companies were absorbed by the Dominion Bridge Co. Mr. Vaughan joined the staff of the latter as vice president and general manager.

The total amount available for the 1918 program is $7,700,000, which must cover both construction and maintenance. Every effort is being directed toward a completion of the details of the program, so that contracts may be made as soon as the season opens.

Railway Engineering Association Nominations Announced

C. A. Morse, chief engineer of the Chicago, Rock Island & Pacific Ry., has been announced as nominee for president of the American Railway Engineering Association for the coming year. H. R. Safford, chief engineer of the Grand Trunk Ry., is nominated for vice president. George H. Bremner and E. H. Fritch are renominated for treasurer and secretary, respectively.

Three directors are to be chosen from the following nine candidates: J. L. Campbell, El Paso & Southwestern; J. E. Crawford, Norfolk & Western; J. M. R. Fairbairn, Canadian Pacific; E. A. Frink, Seaboard Air Line; John V. Hanna, Kansas City Terminal; E. H. Lee, Chicago & Western Indiana; H. T. Porter, Bessemer & Lake Erie; E. B. Temple, Pennsylvania, and Prof. F. E. Turneaure, University of Wisconsin.

Five members of the nominating committee are to be elected from these ten nominees: J. E. Crawford, Norfolk & Western; Arthur Crumpton, Grand Trunk; B. J. Dalton, Missouri, Kansas & Texas; H. T. Douglas, Jr., Chicago & Alton; John V. Hanna, Kansas City Terminal; A. J. Himes, New York, Chicago & St. Louis; J. B. Jenkins, Baltimore & Ohio; J. A. Peabody, Chicago & North Western; A. R. Raymer, Pittsburgh & Lake Erie, and J. E. Willoughby, Atlantic Coast Line.

Four Indiana Engineering Societies Meet Together

War topics, market highways, concrete ships and vocational education occupied to the full the one-day convention, Jan. 25, of the Indiana Engineering Society held in conjunction with the Indiana sections of the American Society of Electrical Engineers and American Society of Mechanical Engineers, and the Indianapolis Engineers' Club.

W. S. Moore, state highway engineer, explained the designated 800 miles of main market highways which the newly created commission has selected out of the 2000 miles to be developed. The commission has decided to use nothing but hard surfaces on a minimum width of 18 ft., because 85% of the traffic of the state is borne on 15% of the roads. Mr. Moore is of the opinion that it is in the interest of the state to build the roads for motor trucks, and not the trucks for the roads.

Surveys are complete for 100 miles, one-half of the mileage for which money is available from state and counties, each bearing one-half the cost. Much of this 200 miles may be built by team and motor-truck haul.

A legislative committee, headed by J. W. Mueller, recounted the experience of the committee on piloting through both houses of the legislature a bill to raise the compensation of county surveyors above the time-honored $5 per diem rate, only to have it vetoed by the governor. A bill for the licensing of engineers, designed as a companion to a proposed architects' law, which cut out structural engineers, was urged and was withdrawn when the architects recalled their bill.

The newly-elected officers are W. S. Moore, president; Prof. G. A. Young and J. T. Wilkins, vice presidents; Charles Brossmann, secretary.

New York City Plan and Scope Committee Abolished

The New York City Board of Estimate voted Feb. 2 to abolish its Committee on City Plan and Scope, created under the recent Mitchel administration to deal with city planning matters. Assuming that no appointments will be made to carry on the work under some other name, $21,400 of salaries will be saved, including $5000 a year paid to Robert H. Whitten, secretary. The engineering force of the committee included George W. Tuttle and Edward M. Law, assistant engineers, and two draftsmen.

Canada Will Tear Up 750 Miles of Branch Lines To Get Rails

Between 1500 and 2000 miles of rails on the less important railroad lines in Canada are to be taken up to supply the main lines, according to a decision reached recently by the Canadian Railway War Board. Which lines will be torn up is to be determined later. It is estimated that at least 20,000 laborers will be required for the work, and in view of the shortage of labor the Dominion Government will be asked to hold certain classes of laborers, including Chinese coolies, passing through Canada to Europe.

Norwood Seeks Town Manager

Owing to the resignation of Clarence A. Bingham to become city manager of Waltham, Mass., the town of Norwood, Mass., is advertising for candidates for the position of town manager. Applicants should state their experience and qualifications in their first letters, which should be addressed to Oliver J. Barr, clerk of the board of selectmen, Norwood, Massachusetts.

Bayonne Votes Down Water-Supply Purchase

Purchase by Bayonne, N. J., of the water-supply conduit owned by the New York & New Jersey Water Co. was defeated at the polls, Jan. 22, by a vote of 2240 to 2127 for the project. This is the third adverse vote. Bayonne owns its distributing system and buys water in bulk from the company.

Western Society of Engineers Enters on Fiftieth Year

War services rendered, financial conditions stabilized, a new vision of activities defined, social problems forecast, were some of the subjects discussed by H. J. Burt, retiring president of the Western Society of Engineers, at the annual dinner and meeting, Jan. 24. More than 100 members of the society, 10% of its enrollment, are represented on its service flag; one-third of its fifteen directors are included.

Through the efforts of the finance committee, headed by D. W. Roper, first vice president, a large number of matters which have been left unsettled during previous years have been cleared up. Practically for the first time the books have been closed on time, so that the incoming board starts with a clean slate. Overdue accounts have been collected, and while the roll indicated a decrease from previous years, the society knows the trustworthy quality of its membership. Expenses have been less than collections, and two $1000 Liberty Bonds have been added to the reserve fund.

The recipients of the Chanute medals for the best papers presented in 1917 are as follows: H. B. Sauerman for a paper in general engineering on "Fortification"; Clinton B. Stewart, for a paper in civil engineering on "Investigation of Flood Flow on the Wisconsin River at Merrill, Wisconsin."

To carry out more effectively the technical aims of the society, which has just entered on its fiftieth year, Mr. Burt asserted that it should participate directly in scientific work. He would resolve the society into an academy of engineering science, every member serving on a committee on some subject of importance to the profession. Such committees could conduct or direct research work; could standardize engineering practice when such standardization is feasible; and could establish the proper relation of the profession to the public and public affairs, not from the viewpoint of the narrow interest of the engineer, but broadly, for the common good.

Wood Preservers Discuss Oils, Flooring and Paving

Wood blocks for street and interior paving, and modifications in specifications for oil for timber treatment, were the main subjects considered at the fourteenth annual meeting of the American Wood Preservers' Association, held in Chicago, Jan. 22 to 24.

For president in 1918 Morris K. Trumbull, vice president of the National Lumber and Creosoting Co., was elected. The vice presidents are J. B. Card and A. R. Joyce. The secretary is F. J. Angier, of the Baltimore & Ohio R.R., Baltimore, Md. The annual meeting of 1919 is to be held in St. Louis, Missouri.

War Engineering in France Described

By Secretary Baker Before Senate—Transportation and Terminal Construction Outlined

A vivid picture of some of the engineering activities behind the line in France was painted by Secretary of War Baker in speaking before the Senate Committee on Military Affairs, Jan. 28. In his address to the Committee the Secretary told of engineering regiments sent abroad; of the building of hospitals; of the construction of docks and wharves at American ports; of the fabrication in this country and the sending over to France of dock-handling machinery and of the piles with which the docks were built; of constructing behind the lines ordnance bases and repair depots; of rebuilding and amplifying a railroad in France 600 miles long, shipping for it from the United States "the nails, cross-ties, spikes, fishplates, engines, cars and buildings."

The Secretary said in part:

"In a very short time we had organized engineering regiments of railroad men and sent them over there and were rebuilding behind the lines of the British and French the railroads which were being carried forward with their advance, reconstructing their broken engines and cars, and building new railroads, back of both the French and British lines.

"Special studies showed that the railroads and the facilities of France during this war had been kept in excellent condition—far better than was supposed possible. And yet they showed that those railroads were used to the maximum to take care of the needs of the French and British themselves, and that when our army became a great army it would be necessary for us to build back of our own lines an independent line of communication.

"The French had naturally reserved the best ports in France for their own supply. The channel ports have been reserved for the British. When we came in it was necessary for us to have independent ports of entry.

"We were given several ports. As you perhaps recall, the ports of France are tidal ports—ports with deep water and tidal basins—at high tides, with insufficient water for landing at the docks when the tide is out.

Difficult Construction Work

"As a consequence, the construction of docks and wharves for tidal basins in ports of that kind is very much more difficult than where you have a deep-sea harbor and all you need to do is to erect a pile wharf. We have had to build docks, we have had to fabricate in this country and send over dock-handling machinery; we have had to send from this country even the piles to build the docks. We have had to have cranes manufactured in this country and sent over to be erected on those docks. We have had to erect over there warehouses at the ports of disembarkation in order that these vast accumulations of stores and supplies which go over can be properly housed and cared for, until they can be distributed into the interior.

"We have had to take over, and are in process of rebuilding, a railroad 600 miles long, in order to carry our products from our port of disembarkation to our general bases of operation. And all of that, gentlemen, has to be done, not only studied out, as a necessary thing to do, but when so studied out and reported here, the manufacture of those things has to be carried out in this country, and the things shipped over there—nails, cross-ties, spikes, fishplates, engines, cars, buildings."

New Instructors at Engineer Officers' Training Camp

The following named officers, Engineer Reserve Corps, have been relieved from duty with the 305th Engineers, and ordered to report to the commanding officer, Engineer Officers' Training Camp, for duty as instructors: Captains Eugene W. Magruder, John W. Swaren, Vinton D. Cockey, Ralph E. Doherty, Thomas S. Newman, Frank R. Allen, Percy W. Ott, Myron D. Reynolds, Ernest W. Schoder, Max A. Berns, Eugene B. Wilhelm, Jr., Robert W. Wood, Christopher T. Chenery, Edward W. Robinson, John H. Thompson, Jr., Herschel H. Allen, Willard See and Conrad G. Fredin.

Eight-Hour Law Has Not Materially Shortened Trainmen's Day

Announcement has been made of the findings of the commission appointed in 1916 to study the workings of the Adamson law, the so-called eight-hour law for railroad trainmen. In yard operation there has been some reduction in the actual hours of work. In road service the reduction has been slight and the main effect of the law has been increase of wages. The added annual cost indicated by figures for January, 1917, is $61,000,000.

The commission consisted of George W. Goethals, chairman; E. E. Clark and George Rublee.

Cut Size of Largest Shipbuilding Plant

Isolated Site and Great Number of Ways Detriment to Early Production of Tonnage, Says Piez

The remoteness of the site at Hog Island, Philadelphia, with respect to transportation facilities, and the unusual size of the plant, which was to contain fifty launchways, are assigned by Charles Piez, vice president and general manager of the Emergency Fleet Corporation, as the reasons for requesting the American International Shipbuilding Corporation, contractor for the fabricated steel ships to be built there, to reduce its program to the immediate completion of the 32 ways which have been begun. Trackage and warehouse facilities required for the 18 ways whose construction will be postponed are not to be provided at present, it is understood.

In a letter signed by Mr. Piez and made public Jan. 30 in the course of an investigation being carried on by the Senate Committee on Commerce, it is admitted that actual construction did not start in the shipyard until Oct. 1, and that three days thereafter the original plan of constructing 200 ships all of one type and size was changed to include 70 vessels of a larger and speedier type.

The estimate of the American International Shipbuilding Corporation, says the letter, did not guarantee the cost of $21,000,000 proposed, but stated that the first of the ways should be finished four months from the time of beginning work and the last 25 days later. This would require the completion of the entire yard by Mar. 1.

Six Reasons for Delay

It is charged in the letter that for six reasons construction progress has not been satisfactory, and that costs have been increased above those estimated.

First, the work was begun so late in the season that much heavy construction had to be carried out under the handicap of severe winter weather.

Second, the railroad facilities in the vicinity of the plant were inadequate for the needs of the construction work.

Third, the isolation of the site made it difficult to obtain and retain experienced workmen.

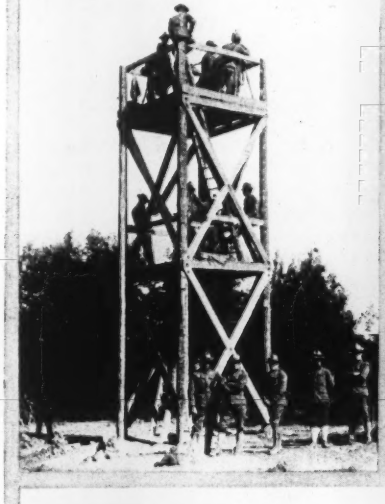
Fourth, inadequate driveways and insufficient temporary trackage hampered the handling of construction material within the plant.

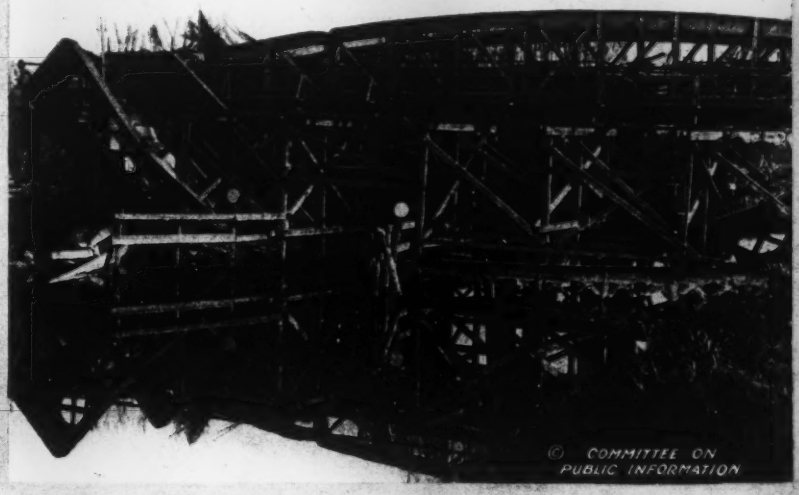
Fifth, "Material seems to have been ordered without regard for actual needs and existing facilities for handling that is necessary to prevent undue congestion on railroads leading to the plant."

Sixth, such great numbers of men have been employed in the effort to increase the speed of construction that the supervising staff was unequal to the task of directing them efficiently.

The letter, as quoted at length in the daily press, does not indicate whether Mr. Piez blames the Emergency Fleet Corporation or the American International Shipbuilding Corporation for these conditions. It has been stated in various quarters that the Emergency Fleet Corporation was dissatisfied with the organization and the work, while on the other hand it is said by men connected with the project that the Emergency Fleet Corporation procured all construction materials, including their delivery, and that its engineering organization was also concerned with the detailed plans.

Some of The Engineer Troops' Handiwork in France





Artillery Observation Tower built by engineers.

French engineers have replaced the old bridge, destroyed in the Aisne sector by gunfire last September, with a new steel structure which the view shows still resting on the falsework.

Built on French soil out of American-made sections, such cantonments are erected in rapid time.

The engineers throw these types of foot bridges across small streams, shell holes and mud flats in the almost impassable sections of Belgium.

Navy Wants Engineers and Mechanics for Aviators

Commissions Open for Skilled Men Who Apply Now—Gasoline Engine Experts and Draftsmen Needed.

The Navy Department announces that men will be selected soon for aviation service. Applicants of suitable qualifications who report now to the Navy recruiting offices are eligible for examination for commissions and ratings. The rates of pay and duties assigned in the aviation work in the Navy make this opportunity highly attractive to mechanical engineers, and to draftsmen, mechanics and others who are experienced in gasoline engine design or operation.

The announcement follows:

1. Officers from the department will, within a very short time, report to you for the purpose of making a selection from the personnel of your district of men to equip for special work in connection with aviation as follows:

(a) Experienced engineers for engineer officers at the various naval air stations. These men will be commissioned in Class 5, and sent to the Columbia University for further engineering training, and thence to the Packard Motor Co., Detroit, for special instruction on Liberty engines.

(b) Experienced gasoline-engine men for further instruction at Columbia University, and special instruction at the Packard Motor Co. on Liberty engines. These men will be given ratings in Class 5, in accordance with their qualifications.

(c) Graduate mechanical engineers and men of experience along engineering lines for special duty in the Bureau of Steam Engineering, and in connection with work of this bureau at various places. Such men will be commissioned immediately in Class 5.

(d) Aëronautical and other gasoline-engine draftsmen for work in the Bureau of Steam Engineering. These men will be given ratings of chief petty officer and petty officer in Class 5, in accordance with their qualifications.

(e) Men who have had experience in compressed gases, especially hydrogen. A limited number of these men will be given commissions in Class 5, and others ratings in Class 5. These men will be used in connection with hydrogen generation for lighter-than-air-craft.

(f) Mechanical engineers for special work under the Bureau of Construction and Repair. These men will be used in connection with the development of aircraft. It is not anticipated that men of previous suitable aëronautical experience will be found, but it is desired to select the best material available and give them further training. Those suitable will be commissioned in Class 5.

(g) Mechanical draftsmen for duty in the Bureau of Construction and Repair on aviation work. These men will be given special aëronautical training as needed. They will be given ratings of chief petty officer and petty officer in Class 5.

(h) Suitable men for training for quartermasters (aviation) and carpenters' mates (aviation) and such other specialists as are not covered by above subheads. Men for training as quartermasters (aviation) should be experienced in fabric work, wire working or any form of light rigging. For carpenters' mates (aviation) boat builders are especially desired, but any men with woodworking experience will be considered.

2. It is desired that this letter be published throughout your district in order that such men as consider themselves qualified for any of the above duties may apply for examination. The time and place or places where these examinations will be held will be designated either by telegraph or by the senior officer of the examining party.

Full information may be obtained at any Navy recruiting office.

Labor Distribution Planned for War Industries

Federal Department of Labor Completes Survey of Conditions in New York State

As a first step toward government control of labor distribution on war work, a report just issued by the Department of Labor, outlining the results of a survey of labor conditions in New York State to stop competitive bidding for labor among the war industries, which is now hampering important production. Coöperation with organized labor in the various crafts and trades is recommended.

Seven hundred firms in forty-one cities in New York State were interviewed. Of these five hundred were filling contracts in their own factories. Others were jobbers or sales agents who were having the work done in other states.

It was discovered that there was both shortage and surplus of labor in the same trades. For instance, while there was a severe shortage of machinists, forge hands and molders in plants working on ordnance, airplanes, motor trucks, submarines, tractors and railway supplies; there was a surplus of these classes of labor among such industries as pleasure automobiles, cream separators, bicycles and art metal goods.

The chief industries now experiencing a shortage of labor are those making airplanes and seaplanes, 13,474; ordnance and ammunition, 9667; iron and steel castings, 2056; scientific instruments and optical supplies 1755.

It is pointed out by the Department of Labor that until steps have been taken to use all available male labor in important war industries there can be no intelligent control of the entrance of women into industry. So far there has been little substitution of women for men.

The War and Navy Departments and the various war boards working with them are urged to coöperate closely with the Department of Labor. Complete information is needed by the Department regarding war-order contracts, their relative importance and necessary dates of deliveries.

The Department recommends that conferences be held with labor leaders regarding conditions in the various crafts working in both slack and active industries. In making the survey the Department learned that in many of the plants reported shorthanded the needs were not immediate with regard to war work.

The immediate problem in labor shortage was found principally in Buffalo and in Rochester, where the calls were for skilled workers in the metal industries. A surplus of labor was discovered in Syracuse, Rome, Amsterdam and Albany.

As a tentative plan for removing workers to the war industries centers, the Department suggested that under governmental control transportation costs could be shared equally by the government and the management of the industries to which men are supplied.

Census Bureau Gives Out Latest Figures on Shipping

At the end of 1916, the latest date for which figures are available, the gross tonnage of American-owned merchant vessels of five tons register or over was 12,250,000, of which nearly 8,000,000 tons were oceangoing. The official statement in part is as follows:

According to a preliminary report compiled under the supervision of Eugene F. Hartley, chief statistician in charge of the recent water-transportation inquiry, made as of Dec. 31, 1916, American-owned merchant vessels of five tons net register or over, of all classes, operating during the year 1916 on the coast or inland waters of the United States, including Alaska, or between ports of the United States and foreign countries, numbered 37,894 and had a total gross tonnage of 12,250,000. (Gross tonnage is calculated by dividing entire internal capacity in cubic feet by 100.) The geographical distribution of this gross tonnage was as follows: Atlantic Coast and Gulf of Mexico, 6,509,000; Mississippi River and tributaries, 1,621,000; Pacific Coast, including Alaska, 1,186,000; Great Lakes and St. Lawrence River, 2,738,000; canals and other inland waters, 196,000. The distribution according to method of propulsion was: Steam and other power, 6,098,000; sail, 1,089,000; unrigged, 5,063,000.

The increase in number of vessels, as compared with 1906, was equal to only 1½ per cent., and the gross tonnage shows a decrease amounting to 5 per cent. This is accounted for by the marked falling off in number and ton-

nage of sailing vessels and in tonnage of unrigged craft. The former show a decrease in number from 7131 to 2979, or 58 per cent., and in gross tonnage from 1,704,000 to 1,089,000, or 36 per cent. Unrigged craft, although increasing slightly in number from 20,263 to 20,334, or four-tenths of 1 per cent., show a decrease in tonnage from 7,130,000 to 5,063,000, or 29 per cent. On the other hand, craft propelled by steam and other power increased in number from 9927 to 14,581, or 47 per cent., and in tonnage from 4,060,000 to 6,698,000, or 50 per cent.

The average tonnage per vessel for the country as a whole decreased from 345 in 1906 to 323 in 1916.

Michigan Engineers Hold Co-operative Meeting

War-road programs, trench-mining warfare and military sanitation were subjects fully treated at the convention Jan. 29-31 of the Michigan Engineering Society at Grand Rapids. This organization has recently increased its membership and attendance at its conventions. More than 200 city and county engineers, county surveyors, highway engineers and university professors met. The success of the convention was due in no small measure to the efforts of the Grand Rapids Engineering Society.

In a paper on "War-Time Roads for Michigan," Frank F. Rogers, state highway commissioner, explained the war routes which the truck and automobile manufacturers of the State agreed to use after discussing the subject at Detroit on Jan. 25. The highway department has been asked by the War Board of Michigan to open these roads so that "driveways" may be made during the winter. The war route agreed upon includes Alma, Saginaw, Flint, Fenton and New Hudson. Here one branch goes to Detroit, thence to Monroe and Toledo, the other to Lansing, Battle Creek, Kalamazoo, St. Joseph and Chicago. Trucks carrying freight over established routes have been declared common carriers in Michigan by the attorney general.

Michigan constructed 1053 miles of roads receiving state reward, but if the same rate is maintained as during the latter half of 1917, but 751 miles can be built in 1918. The shortage would be greater were it not for the fact that 60 per cent. of all state-reward roads are of gravel with the material within wagon or truck-hauling distance. In the Upper Peninsula 75% of the stone for macadam roads is delivered without rail haul.

Capt. Robert Lausel, a French army engineer and instructor at Camp Custer, spoke on mining operations in trench warfare. Details of the construction of a 3-mile asphaltic concrete road to Camp Custer were given in a paper by J. K. Norton, resident engineer, State Highway Department. In discussion L. C. Smith, deputy state highway commissioner, gave the cost as $2.40 per yard, of which the concrete base cost 80 cents and the top $1.18. The road passes over a swamp. As the fill had no time to settle before the concrete was deposited, the road will be watched with more than usual interest. Snow has been removed by the army forces so that the surface is receiving more punishment than in summer due to the continual use of tire chains.

Water supply at Camp Custer was described by Don W. Bingham, and the disposal of industrial wastes by Jacob L. Crane. Both are assistants of the state sanitary engineer. Municipal papers included one by Gaylord C. Cummin, city manager of Grand Rapids, on "The Engineer in Public Service." The engineers of the state are anxious for legislation on licensing. W. J. Leyner, county road engineer, Mount Clemens, presented arguments on the question of registration.

For 1918 the officers elected are as follows: President, E. D. Rich; vice-president, L. C. Smith; treasurer, A. J. Decker; secretary, W. W. Cox, Kalamazoo.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN INSTITUTE OF MINING ENGINEERS, 29 West 39th St., New York; Feb. 18-21, New York.

AMERICAN RAILWAY ENGINEERING SOCIETY, 910 Michigan Ave., Chicago; Mar. 20-22, Chicago.

The Lewis Institute Branch (Chicago) of the Western Society of Engineers is giving a series of public lectures on aviation. Lieut. Col. N. H. Slaughter, assisted by Lieutenant Cawing, Signal Corps, U. S. A., presented the first address Jan. 30 on "Technical Features of Radio Communication." The series will continue on Thursday evenings and includes meteorology, airplane construction, engines, instruments and bombing. The principal object of the course is to supply certain fundamental knowledge of these subjects to prospective applicants for admission to the aviation section of the Signal Corps.

The next annual convention of the **Minnesota Surveyors' and Engineers' Society** will be held at Duluth Feb. 21-23.

At the annual meeting of the trustees of the **United Engineering Society**, New York, held Jan. 24, the following officers were elected for the ensuing year: President, Charles F. Rand, member of the American Institute of Mining Engineers; first vice president, Calvert Townley, member of the American Institute of Electrical Engineers; second vice president, Robert M. Dixon, member of the American Society of Mechanical Engineers; treasurer, Dr. Joseph Struthers, member of the American Institute of Mining Engineers; secretary, Alfred D. Flinn, member of the American Society of Civil Engineers; chairman of the finance committee, J. Vipond Davies member of the American Society of Civil Engineers.

The Toronto branch of the Canadian Society of Civil Engineers held its annual meeting Jan. 17 and elected the following officers: Chairman, Prof. Peter Gillespie; secretary-treasurer, George Hogarth; executive committee, J. R. W. Ambrose, Willis Chipman, E. L. Cousins, Prof. H. E. T. Haultain, E. G. Heuson, and R. O. Wynne-Roberts.

The Engineers' Club of Trenton, N. J., at a smoker, Jan. 24, listened to an address by the president of the club, F. C. Carstarphen, and one by J. B. W. Gardiner, New York City. Both addresses dealt with the war.

The tenth annual convention of the **North Dakota Society of Engineers** will be held at Fargo, Feb. 21-22. The program includes regular reports on or special discussions of municipal improvements, specifications, roads, drainage, concrete, lignite mining and fuel distribution, the engineer's part in the war, the engineer's position as a citizen, and other topics of importance.

At the meeting of the **Detroit Engineering Society**, Feb. 1, Clifford Richardson, consulting engineer for the Barber Asphalt Paving Co., spoke on "Asphalt and Its Application to Street and Road Construction." The address was illustrated with motion pictures.

At the recent annual meeting of the **Ohio Water-Works Association**, John A. Poland, Chillicothe, was elected president, S. F. Messer, Kent, vice-president, and F. C. Jeannot, Wilmington, secretary-treasurer. At the meeting Sergt. J. Reynolds, of the British Mission to the United States, and Adjutant Henri Jay, of the French Army, both instructors at Camp Sherman, gave their experiences of three years in the trenches.

The Engineers' Club of Springfield, Ill., has elected the following officers for 1918: President, H. B. Lewis, plant superintendent, Central Union Telephone Co.; secretary, J. R. Hughes, assistant engineer, State Public Utilities Commission.

A civil engineers' society composed of sophomores, juniors and seniors was formed Jan. 25 at the University of Minnesota. There are now three engineering organizations on the campus, the mechanical, electrical and civil. It is the intention to organize these three societies further through a joint board or council, so that they may work in harmony and obtain speakers who will

address the three bodies jointly, and the three organizations will work singly in matters pertaining only to each branch. The newly formed body was addressed by George H. Herrold, of the Department of Public Works of St. Paul, at the organization meeting. The subject of his address was "The Engineering Student After He Leaves College."

PERSONAL NOTES

WALTER W. SCHWARZ, formerly county engineer of Clark County, Vancouver, Wash., has been retained by the Standifer Construction Co., builders of steel ships, at Vancouver, as consulting engineer.

GEORGE A. SOPER, consulting engineer, New York City, has been commissioned major in the Sanitary Corps, National Army.

W. T. PRESTON, assistant engineer of the U. S. Engineering Corps for Washington, Idaho, Montana and Alaska, has been appointed district engineer of the corps to succeed COL. GEORGE A. ZINN, who has been transferred to Portland, Ore., as division engineer.

CHARLES EVAN FOWLER, consulting engineer, New York City, lectured to the students in civil engineering at Lafayette University, Easton, Penn., Feb. 4, on "The Practical Aspects of Engineering Education."

ARNOLD B. MACSTAY has been appointed Commissioner of Street Cleaning of New York City, to succeed Commissioner Fetherston. Mr. MacStay was secretary of the department under Commissioner Fetherston, and after that was Deputy Commissioner, with headquarters in the Bronx. When Fetherston resigned on Dec. 31 last, Mr. MacStay was appointed Acting Commissioner by Mayor Hylan. The salary is $7500 a year.

R. M. HUBBARD, New Boston, was appointed state highway commissioner of Texas, Jan. 22. Curtis Hancock has been reappointed chairman of the commission and James G. Fowler has been named as a member of the commission.

ROBERT K. WEST, state highway engineer of Nevada, has been commissioned captain in the 53d Engineers, at Camp American University, Washington, District of Columbia.

J. E. CARROLL, superintendent of construction of the Department of Public Works, St. Paul, Minn., has been commissioned a major and has been ordered to Camp Lee, Virginia, for service.

PROF. ADOLPH F. MEYER, assistant professor of hydraulic engineering, University of Minnesota, has been elected president of the civil engineers' society of St. Paul for the ensuing year.

C. E. NAGEL has been appointed district engineer for the Portland Cement Association, with headquarters at St. Paul. Mr. Nagel was until Jan. 1 bridge engineer for the State Highway Commission of Minnesota.

WILLIAM A. DOERRIES, until recently with the A. Pew Construction Co., Atlanta, Ga., as resident engineer in charge of sewer and water-works construction at Tennille, Ga., is now with the Empire Refining Co., as assistant resident engineer at its Ponca City, Okla., refinery.

H. O. GARMAN, chief engineer of the Indiana Public Service Commission, has been appointed chairman of a committee on inventions by the Indiana State Council of Defense. Other members are O. H. SKINNER, superintendent of the Prestolite Co., and W. H. WRIGHT, superintendent of the Citizens' Gas Co., Indianapolis.

ALEXANDER POTTER, consulting engineer, New York, has been engaged by the U. S. Government to act as consulting engineer in the design and construction of the sewerage, drainage and water-supply systems for the new U. S. Government explosives plant to be located near Charleston, W. Va., upon which the Government will expend about $60,000,000.

W. O. GALBREATH has been appointed chief engineer of the Missouri, Oklahoma & Gulf Ry. in succession to N. C. Van Natta. His office is at Muskogee, Oklahoma.

L. R. WALKER has resigned from the engineering department of the Trussed Concrete Steel Co., Youngstown, Ohio, to accept a position with the Imperial Irrigation District at Calexico, California.

C. W. BAGGOTT, formerly assistant engineer on the Chicago Drainage Canal, chief engineer of Lincoln Park, Chicago, and recently engaged in the dredging contracting business in northern Minnesota, has accepted a position as superintending engineer for R. H. & G. A. McWilliams, dredging contractors, Chicago.

J. M. ROESCHLAUB, who has been resident engineer of the Denver & Salt Lake R.R., with headquarters at Denver, has been advanced to the position of chief engineer.

R. P. BOYD, engineer for the two Ouachita, Louisiana, parish road districts, has been made road engineer for the entire parish.

J. S. SPIKER was recently appointed city engineer of Vincennes, Indiana.

EDGAR H. ANNEAR, Modesto, Calif., has been appointed Captain in the Engineer Reserve.

L. MCCLELLAN BOBEAU, until recently works engineer for the Transcona Shell Co., Transcona, Manitoba, Can., is now serving in the same capacity for the Batavia Steel Products Corporation, Batavia, New York.

FRED. C. SCOBEY, senior irrigation engineer, Irrigation Division, Office of Public Roads and Rural Engineering, Washington, D. C., has been transferred to Berkeley, California.

CHARLES S. BILYEU, who became associated with the Gulick-Henderson Co., New York, several months ago, has been made assistant to the president.

C. I. FELPS, until recently bridge engineer with the Kansas State Highway Commission, is now with the 23rd Engineers.

A. J. HAHN, for the past year junior highway engineer, Illinois State Highway Department, has been ordered to service with the 416th Railroad Battalion, National Army.

H. L. RAMAGE, recently of Westinghouse Church Kerr & Co., has resigned as junior assistant engineer on the New York State Barge Canal and has accepted a position with the Atlas Portland Cement Co. at Northampton, Pennsylvania.

DAVID A. DECKER, until recently of Beaufort, N. C., is now connected with the office of the city engineer of Norfolk, Virginia.

DONALD G. COOMBS, until recently connected with the U. S. Reclamation Service at Meadow Creek and Rimrock, Wash., has accepted a position in the construction department of the Braden Copper Co., at Rancagua, Chili.

C. R. WALKER has obtained a leave of absence from the valuation department, Pennsylvania Lines West of Pittsburgh, to attend the third officers' training school at Camp Sherman, Chillicothe, Ohio.

C. A. BINGHAM, town manager of Norwood, Mass., has been appointed city manager of Waltham, Massachusetts.

C. M. ADAMS has been appointed city engineer of Bellingham, Wash., succeeding W. H. North.

OBITUARY

J. MONROE SMITH, former city engineer of McKeesport, Penn., died Jan. 24. He was 41 years old. Mr. Smith became city engineer in April, 1909, going to the city from the National Tube Co., for which he was chief field engineer. He was graduated from the Massachusetts Institute of Technology in 1903, and was employed for a time by the Pennsylvania R.R. Company.

REUBEN J. FLAHERTY, civil engineer, designer in the power plant of the Ford Motor Co., Detroit, died at his home in Detroit Dec. 29.

INDUSTRIAL NEWS AND COMMENT

ABOUT MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Relief From Coal Shortage May Come With Thaw

Coke Scarcity Limits Pig Iron Output—Middle West Hit by Steam Coal Shortage

Cold weather continued to restrict coal shipments to manufacturers and to limit the output of iron and steel by reducing the movement of coke to the blast furnaces. Improvement was reported in Pittsburgh due to the milder weather of late last week. This improvement was also felt at the seaboard, manufacturing and shipping centers, particularly at New York, where coal receipts were nearing 2000 carloads a day—the normal requirement at this season.

The freight embargo on the lines of the Pennsylvania, B. & O. and Reading is still in force and will hamper many manufacturers of construction equipment and materials.

Investigation by *Engineering News-Record* revealed that some manufacturers of equipment for shipyards and some sub-contractors on Navy Department work were unable to ship finished products because they did not know where to appeal when freight was refused by local agents of the railroads. It was learned that appeals should be made to the particular Board or Bureau of the Government department interested. An order from this source will be recognized by the railroad companies on the embargoed lines and the shipment will be moved by the carriers.

Middle States Hard Hit

Most of the big steel plants near Chicago cut down to 60 per cent. production after the storms had shut off coal shipment. The Inland Steel Company is running at 80 per cent. of capacity as it had large stores of coking coal brought in by lake during the summer. It was short of steam coal, however. In Detroit the coal scarcity became severe after the blizzard of Jan. 26-7, and a number of plants were forced to close. Among them was the big Morgan & Wright plant of the U. S. Rubber Co.

At Cleveland the coal shortage continued acute. The White Company, one of the few big industries having ample coal on hand, shared its supply with the municipal lighting plant.

In Columbus and other Ohio industrial centers the coal shortage continued to limit production, some relief being apparent late in the week.

Coke Shortage Severely Felt

In Pittsburgh the blast furnaces are setting the pace for the production of the steel mills. Blast furnaces, in turn, are limited by the receipts of coke. River shipments of coke and coking coal are tied up by ice in the Monongahela. Rail shipments are delayed by snows and lack of motive power.

In the Connellsville coke district some relief was in sight on car shortage.

Blast furnaces in Pittsburgh were working at about 50 per cent. capacity and the average output throughout the Central West was ranging from 60 to 70 per cent. of normal.

It is stated that the Government is extending its control of coke distribution, by the establishment of "coke zones," each in charge of a director, who will work in conjunction with the producer. The relative urgency of various Government work is said to be the basis for regulating shipments.

Cleveland Plans To Speed Up War Industries

Under the leadership of Charles A. Otis, president of the Cleveland Chamber of Commerce, a concerted effort is being made to correlate the industries of the city, in order to bring production to a maximum in war work. In the deliberations at Washington the proposed building of a great munition plant in Cleveland was discussed. Sufficient analysis has been made of the field to convince those making the local study that it would be much better to develop the plants already in the field.

It is planned that production engineers shall make a study of each plant. It was pointed out that the increased efficiency of many plants would count tremendously after the war, whereas a big plant built for war purposes would be a "white elephant." It would take 18 months, according to several experts in production, to get an organization together and tuned up in a big plant (18 months, including building of plant) whereas small plants can be correlated and tuned up in not more than six months.

Guy E. Tripp Made Ordnance Executive

Guy E. Tripp, of New York, heretofore chairman of the Westinghouse Electric and Manufacturing Co., has been appointed by the War Department as Chief of the Production Division of the Ordnance Department and commissioned as colonel. He is intrusted with the task of supervising and stimulating the production of all ordnance supplies. The appointment of Mr. Tripp is one of the important steps in the reorganization of the Ordnance Bureau, announced recently by its chief, General Crozier.

COL. GUY E. TRIPP

Mr. Tripp was selected because of his experience in the manufacture of munitions of all kinds, the Westinghouse Co. having obtained large contracts from the British and Russian governments immediately on the outbreak of the European war. Mr. Tripp is credited with bringing to the department the highest obtainable type of experience, and ability to insure speedy and careful production of munitions. The Board of Directors of the Westinghouse Co. has given him a leave of absence for the duration of the war.

Waldo H. Marshall Enters the Ordnance Department

Waldo H. Marshall, of New York, formerly president of the American Locomotive Co. and now associated with J. P. Morgan & Co., has been appointed assistant chief of the Division of Production of the Ordnance Department. The appointment was announced by Col. Guy E. Tripp, chief of the department.

Coal-Handling Equipment Wanted

Plans are being prepared and bids will soon be requested for coal-handling apparatus to be installed at Pelham Bay Park, N. Y., by the Bureau of Yards and Docks of the Navy Department. Specification No. 2814 covers this work.

Rail Situation Results in Erratic Prices

Producers of Building Materials To Save 1,500,000 Tons of Coal—Better Volume of Work, Though of Different Character, in Sight

Those prices which have been fixed by the Government remain remarkably steady, while prices of other building materials have varied during the month almost solely with the transportation situation at the locality in question. The abnormal prices of sand and gravel at New York, for instance, appear to be purely temporary, and due in the first place to the shortage of barges and tugs, resulting from continued severe weather and the fuel situation. In this connection it has been reported that curtailment of manufacture to save fuel would be asked in the case of building products. This, however, in view of the fact that the entire 1,500,000 tons of coal which these industries are expected to save represents but 15 per cent. of the consumption of the cement industry alone, is not expected to limit construction work so much as the new plans for restricting credit. It is said that the heaviest curtailment will be asked of those industries whose products are used in ornamental work, and for residential building, the production of many kinds of construction material having actually to be increased on account of Government demand.

Construction Takes New Trend

The assumption by the Government of control over the credit market is the only logical step to take in such a war. It is not likely to mean less construction work, however, but to indicate work along lines different from those developed before the entry of this country into the war. In fact, figures for the value of new construction projected in December for about 45 per cent. of the country indicated $250,000,000 to be spent, of which $76,000,000 was for the Government on the Atlantic coast. This compares with $130,000,000 for November and $155,000,000 for December, 1916, in the same territory.

But with Government control of all credit for such purposes, what is to be the character of this new building? Certainly, industrial plant construction will not assume the enormous proportions which have made the past two years so remarkable. For it has been demonstrated that we already have enough factories to make more war and other products than our transportation facilities can handle. Of course, there will be some industrial building for those industries which have not yet developed sufficient output for the war. There will also be without doubt a continuation of the mushroom construction of purely war facilities which was so conspcuous a feature of 1917.

But it is to other lines that the careful contractor of 1918 will look for work. First of these is industrial housing, into which the Government itself is already going on a tremendous scale. It is axiomatic that workers cannot be expected to produce unless they have a chance to enjoy decent living conditions which are within the reach of their means. Many and many a city, especially along the seaboard and in the central industrial districts, has found itself swamped with an influx of workers which even normal building construction would not have housed. And this class of building has been far below normal for a long time. It may be expected, then, that both the Government itself and those industries to which credit may be extended for the purpose, will build dwellings of a substantial, but not expensive sort on a scale never before seen in this country. As most of this work will be in the nature of large developments, the big general contractors will be attracted to the field, which so far is comparatively new to them. As usual, these firms which go into the game with the realization that it is a brand new one and will have to be closely studied and carefully carried out, will make money, while others may lose.

Railroad Work in Sight

But there is another class of construction work which during the past few years has almost become a lost art, and which is more than likely to again spring into prominence. It is railroad work. Perhaps the Government will not find it necessary in the immediate conduct of the war to tap new territory with long lines of rail, or to carry out many of those projects which represent a great outlay for the shortening of a few miles of line, and which would take years of saving in operation to pay for. But it is likely, on the other hand, that extra tracking may be required to some extent, and that operating connections, yard and terminal facilities may be required in considerable measure. Many additional freight terminals and storage warehouses are already being built. However, the first need of our railroads is sufficient locomotives to keep the rolling stock they have moving over the lines already in existence, and this need will doubtless be met first, both by increased building of motive power and by the advent of warmer weather, before much construction is undertaken.

The contractor who first makes a success of road construction on a scale comparable with railroad or industrial building may revolutionize that field, in which there is sure to be plenty of activity during the coming season. The matter is one of administration, and many have held that it was not feasible. Perhaps conditions of Federal control and percentage contracts will make it unlikely that important trials of this sort will occur; but the opportunity is yet worth watching.

Ohio Building Industries Exhibit

More than one hundred exhibitors displayed modern building materials, concrete equipment and allied products at the Columbus Real Estate and Building Show which opened at the Ohio Fair Grounds, Jan. 23. Special attention was attracted by the exhibits of the Sewer Pipe Manufacturers Assn., the Atlas Portland Cement Co. and the Ohio Hydrated Lime Company.

One of the features of the show was a modern bungalow built by the Columbus Lumber Exchange. The building was started just before the shop opened and was completed in less than two days. The entire bungalow is furnished and is equipped with all modern housekeeping conveniences.

In conjunction with the show the annual meetings of a number of building and lumber associations were held in Columbus. Among them were the Ohio Builders' Supply Assn., the Ohio Assn. of Retail Lumber Dealers, the Union Assn. of Lumber, Door and Sash Salesmen, the Ohio Water-Works Assn. and the Ohio State Assn. of Builders' Exchanges.

At the session of the last named resolutions were adopted urging state, city, county and other public officials to proceed with all possible building operations during this year.

Building Men Will Plan War Work at Convention

Shortage of housing for workers in the war industrial centers will be discussed by members of the National Association of Builders Exchanges during their annual convention in Pittsburgh Feb. 5 to 7. Plans for the conduct of the building industries during the war and for coöperation with the Government in every possible way will come up for action at the convention.

Propose War Bank To Finance Government Contractors

Speed in the output of war supplies is expected to result when the plan to finance the war industries presented to Congress by Secretary McAdoo is put into effect.

The $500,000,000 Government corporation proposed is expected to finance the manufacturers now handling war work, either by purchasing their securities or by advancing loans. A manufacturer handling a $20,000,000 war contract who needs half that sum to go ahead with his work may now face the problem of placing the loan through as many as twenty banks, owing to the limit placed by law on a bank's loans to any individual company. The Government, however, will be in a position to advance the entire sum.

Loans to the extent of eight times the capitalization of the "War Bank" will be permitted in case the bill becomes a law.